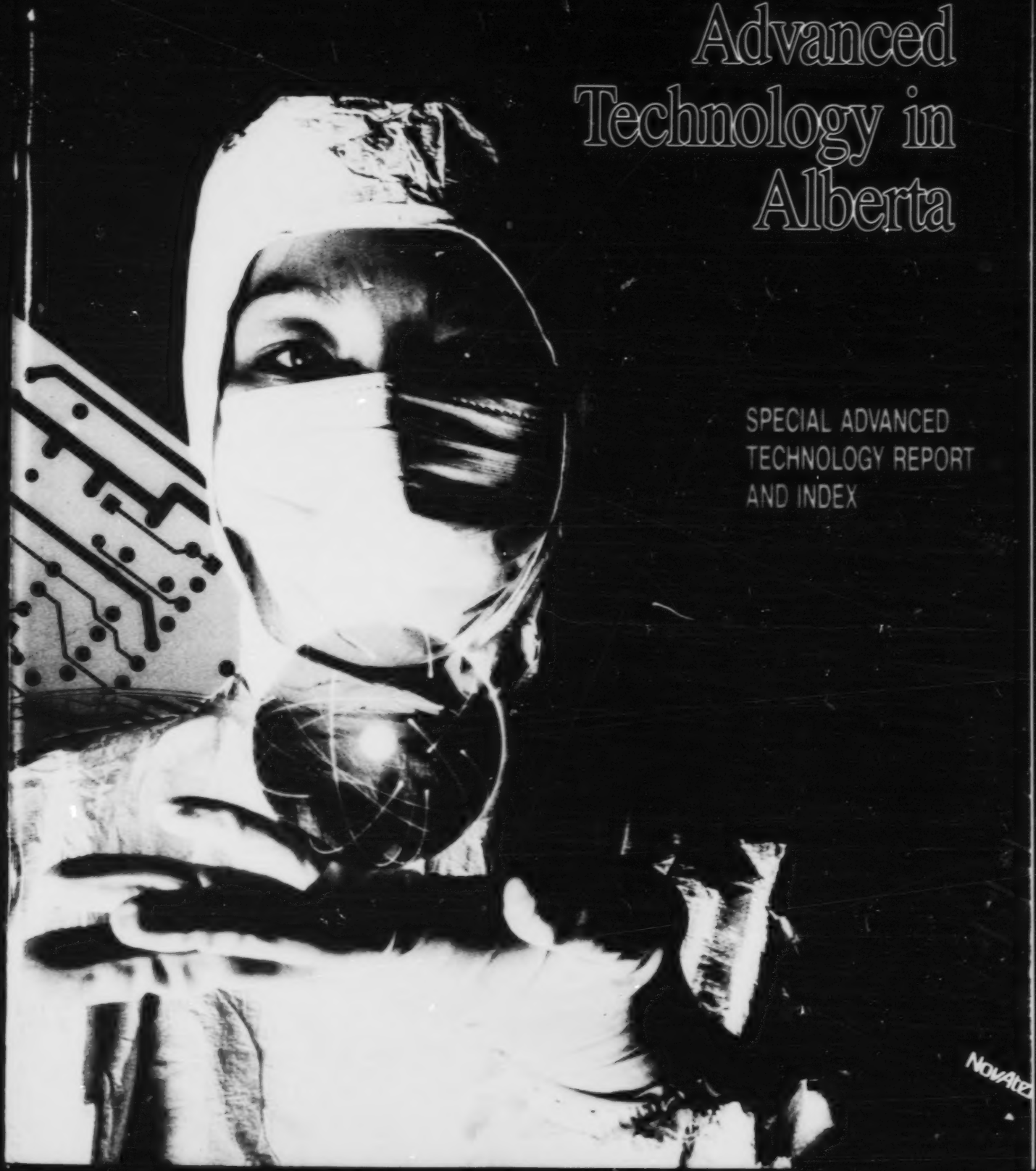
Advanced Technology in Alberta



SPECIAL ADVANCED TECHNOLOGY REPORT AND INDEX

NOVA

Canada in the World

From May 27 to 29, Edmonton will host the "NATIONAL FORUM OF SCIENCE AND TECHNOLOGY ADVISORY COUNCILS." Only the second such gathering in Canadian history, it will attempt to define Canada's future in a high-tech world. The challenge is enormous. Canada's traditional reliance on natural resources and primary industries will not sustain our impressive standard of living. As a country we need to expand into new areas, develop new industries, take bold and risky leaps into new technological areas. We more than have the ability. What we need is the leadership and will to get it done.

A country's commitment to science and technology is usually quoted in terms of "Gross Expenditure on Research and Development," or GERD The higher the GERD, the more committed the country to a prosperous future. Canada currently spends about $6.2 billion on science and technology every year. That's sixth on a list of first world countries, behind Japan, West Germany, the United States, Britain and France. Even little Italy spends more dollars on science than does Canada. And expressed in terms of a percentage of the Gross Domestic Product (GDP), Canada falls to a dismal ninth place among leading world countries. We currently spend about 1.4% of GDP on science and technology. Japan, in comparison, spends 2.87%, more than double Canada, and Sweden spends 2.82%. Even Norway outstrips Canada as a centre of scientific development.

To rectify this performance, Canada's leading scientists, researchers, economists and politicians gathered last year in Halifax for the first National Forum of Science and Technology Advisory Councils. They made a desperate call to increase Canada's expenditure of GERD in relation to GDP to rise to 2.58% by the year 2000. The forum being held in Edmonton in late May will discuss strategies for reaching this goal. It's a critical task. Says co-chairman of the Edmonton forum, Eric Geddes, "We can talk all we want. What we need are steps to be taken to improve the situation." In Halifax, we got a delineation of the problem, he says. "We set national targets, now we need industry targets, sector performance targets and so on. We need the details."

Canada's future hangs in the balance. The decisions made today will make or break Canada's economy. It can be accomplished, but not without a dedicated effort from all citizens.❖

Alberta in Canada

The indicators suggest Canada's performance is improving and Alberta can shoulder some of the credit. Today it spends more money per capita on science and technology than any other province. Total provincial expenditures reached over $240 million last year, third highest in the country. And the science and technology sectors produced billions of dollars in revenues last year, third only to energy and tourism as economic engines in Alberta. Today over 50,000 Albertans are directly employed in about 1,200 advanced technology companies. All told, science and technology supports over 200,000 Albertans and the number may grow to over 500,000 by the year 2000.

Much of this success is attributable to a long-standing government plan to diversify the economy. Starting in the early seventies, the province has set aside billions of petro-dollars in the Heritage Savings Trust Fund to prepare

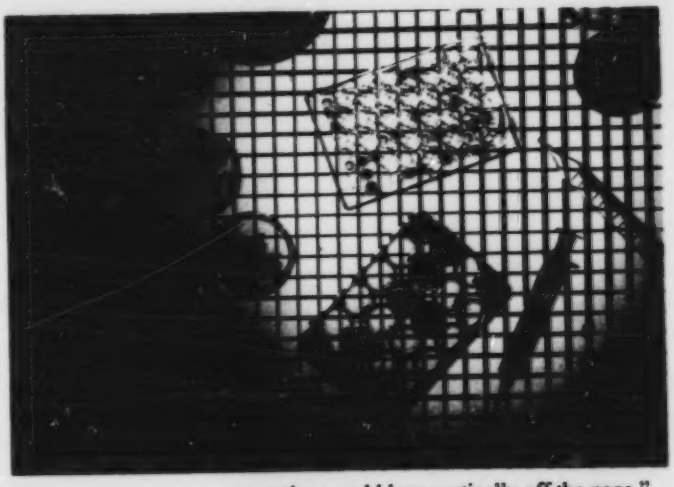
for the day when the oil runs out. The work has already started. In 1979, for example, the province founded the Alberta Heritage Foundation for Medical Research with a $300 million endowment. It has since supported over 2900 medical researchers and students in probing the intricacies of medical science. As a result, Alberta is recognized worldwide for its excellence in medical research and care.

And the commitment to diversity through advanced technology received a major boost in 1986 when Premier Don Getty created the Department of Technology, Research and Telecommunications to coordinate science and technology efforts in Alberta. Now led by the Hon. Fred Stewart, the department is creating an infrastructure to support advanced technology through the twenty-first century. Such centres for excellence as the Alberta Research Council (established in 1921), the Alberta Laser Institute, the Biotechnology Pilot Plant and a dozen others are all making the province an attractive place to do business and guaranteeing the future survival of Alberta.

Still, more work needs to be done. Says Minister Stewart "Our goal is to see the province's technology-intensive industries, as a group, represent one of the largest manufacturing sub-sectors...by the turn of the century. Currently our technology industries account for less than 10 per cent of the value of manufacturing shipments. We are proposing to increase that...to 25 per cent by the year 2000. That means an average annual growth rate of about 15 per cent...."

Work ahead indeed! But read on, and discover the efforts already made and the opportunities waiting for exploitation. Whatever your interests, this is your future. Learn about it. It's exciting!◆

Why High-Tech?



It's a cliche that technology is the greatest engine of change in our world. But it's a misunderstood cliche, not because it's overblown, but because it's underestimated. As a simple measuring stick, ponder the quest to reach greater speeds, as narrated by Alvin Toffler in his book, "Future Shock." In 6000 B.C., man was capable of achieving speeds of about eight miles per hour in a camel caravan, Toffler writes. It took 4400 years after that, to about 1600 B.C., to reach 20 m.p.h. on a horse drawn chariot. It took a further 3500 years for the first steam locomotives to reach speeds near 100 m.p.h. Suddenly, however, man took off. In 60 years, airplanes were hitting 400 m.p.h. and twenty years after that they reached 4,000 m.p.h. All of a sudden, man was circling the globe at 18,000 m.p.h. As Toffler writes, "Plotted on a graph, the line representing progress in the past generation would leap vertically off the page."

That sort of pace can be seen in Alberta today. "Fifteen or 20 years ago the high-tech industry was very small," says Bill Croft, president of the Calgary Research and Development Authority. "But now it's doubling in size every four or five years. By the year 2000, there will be close to 100,000 people

working in the high-tech industries. It will rival the energy industry in Alberta," he says.

Alberta certainly needs something to rival the energy sector. It accounts for about 16% of the province's gross domestic product and directly employs about 80,000 people in 700 companies. Energy-related investment hit $5.5 billion in 1988. But as Albertans painfully learned in the 1980s, reliance on energy is a dubious strategy. The National Energy Policy of 1981 took billions out of the economy and the oil price collapse of 1986 effectively made Alberta one third poorer.

When the oil crunches came, the province had little to cushion the decline. Agriculture, long the second industry, had been dormant for years. A subsidy trade war between the United States and the European Economic Community had driven commodity prices through the floor. Other things like drought, high interest rates and social changes have made agriculture an industry in decline.

Tourism had tremendous potential but it remains a service industry. There's much debate over whether services can ever adequately replace manufacturing as an economic engine. Some say yes, others argue no. At any rate, tourism service jobs are typically low paying and seasonal. And a solid chunk of Alberta's tourism industry is based on the mountains and national parks, areas where environmentalism is slowing development.

That leaves high technology. During the energy collapse, the province targeted high-tech as a promising diversification area. It created the ministry of Technology, Research and Telecommunications in 1986 to oversee efforts in the field and today it can point to more than a few successes. "Diversification is now a reality and becoming more so each day," says Technology, Research and Telecommunications Minister Fred Stewart. "With oil and gas and agriculture still basically flat, our economy is in fact responding. Right now, for example, we have about ten percent of our manufacturing shipments coming from advanced technology. I expect by the year 2000, it will be 25%," he says.

The possibilities are indeed enormous. As a manufacturing-intensive industry, high-tech creates jobs and wealth. Alberta already has a solid technological base provided by the energy industry and many spin-off opportunities have already been developed from that sector. And unlike many other sectors, high-tech doesn't have to be close to its markets. It takes considerable capital and effort, for example, to ship oil across the continent. It takes considerably less to ship computer chips. Furthermore, high-tech is people-oriented. Only highly skilled and educated people can dig into the science and create advanced technology products and services. Calgary already boasts the highest per-capita education rate of any city in Canada. Alberta's two major universities are recognized worldwide for the quality of their graduates and the excellence of their research. And the province has taken tremendous steps to create a "high-tech culture" where science and technology companies can flourish. It's no easy task and will take years to grow, but a high-tech culture is the mark of the future.♦

Growing a High-Tech Culture

STRATEGIES FOR THE FUTURE

What is a "high-tech culture"? It's really a set of attitudes that acknowledges the importance of science and technology and is excited by the opportunities they promise. It's a coherent group of government policies that encourage high-tech research and development. It's a business philosophy that's aggressive and globally-oriented. It's an educational system that makes science exciting and technology intriguing. A high-tech culture is alive, it grows and changes, and feeds on itself. It's intangible sometimes, but it's there and it's important.

Such a culture doesn't just pop into existence. It develops slowly and must be nurtured along. This starts by identifying sectors that can build on the province's strengths. Alberta has several: electronics, telecommunications, computers and software, advanced materials, bio-technology, medical devices, space technology, environmental technology and others. Each area has subgroups. Electronics includes lasers, for instance, and biotechnology includes pharmaceuticals, but each is coherent and generally has the same needs.

The trick then is work on "clusters." Each sector needs a leading company or two, several dozen mid-sized concerns and hundreds of smaller, entrepreneurial companies. These companies feed off each other, trading products and services, experts and cash. In telecommunications, for example, which is the most developed sector in Alberta, Northern Telecom plays the leading company role and NovAtel isn't far behind. Neither company has much interest in producing the plastic cases for their phones. Nor do they have the capability to manufacture microchips, circuit boards or a host of other parts.

So these tasks are contracted out to smaller local companies that have the capability. These suppliers may, in turn, buy parts from other local companies. They, in turn, buy parts from other companies. The whole sector is supercharged by the leading company's role. When a new product is designed, it ripples through the entire sector. Suppliers may be changed, new technology may have to be developed, new expertise may have to be developed.

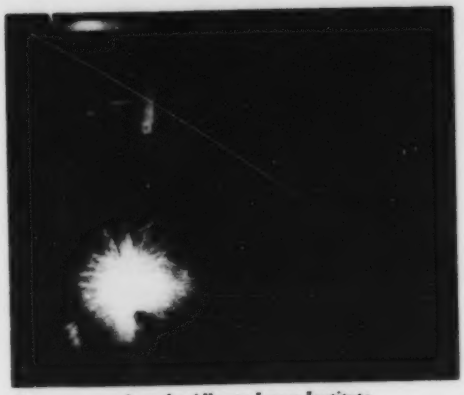
And it doesn't stop with products or services. Personnel move through the sector as well. Perhaps they acquire expertise at the leading company, then spot a niche the leading company is ignoring and so forge their own company. The small company trains people and they may join the leading company or start their own company. Throw in the universities, which create a new batch of experts every year, some of whom join companies or start their own, and the entire edifice becomes a self-sustaining cycle.

All of this takes time and even the telecommunications sector is far from critical mass, the point where the industry takes on a life of its own. Telecommunications in Alberta currently supports about 200 companies and at least another 200 more are needed before things take off. These will develop slowly, but within 10 years critical mass should be reached. Other sectors, like advanced materials, may take far longer. But eventually too they shall reach the point of exponential growth and Alberta will have created a high-tech industry where none existed before.◆

A Helping Hand

Alberta Supports High-Tech in a Myriad of Ways

One of the founding rocks of provincial policy is indirect support for high-tech. The province simply won't give cash to companies to spend as they see fit. Rather it erects support systems and infrastructure to aid companies along the way. Here are just some of the helping hands Alberta offers to industry.



Laser research at the Alberta Laser Institute

Alberta Research Council

The Alberta Research Council (ARC) has a tradition of leading the province into new economic goldmines. Organized in 1921 to lead the province away from a dependence on agriculture, it prepared for the day when oil and gas would dominate the Alberta economy. In 1929 Dr. Karl Clark, a council scientist, patented new techniques for separating bitumen from sand. Those processes are now at work in Alberta's tar sands. Even today the council is developing new techniques for energy extraction and processing.

Now it is breaking new ground in high-tech worlds that promise as great a future as Alberta enjoys today. It keeps over 600 scientists, technologists and support staff busy spending a $65 million budget on high-tech. Projects as diverse as solids pipelining, underground coal gasification, forest products research, biotechnology and electronics testing are widening the depth and breadth of ARC research.

Based in an ultra-modern science centre on the outskirts of Edmonton, the ARC also has offices and research labs in Calgary, Lethbridge, Red Deer, Clover Bar and Devon. The mission is, in part, to marry pure research emanating from Alberta universities with the practical needs of Alberta companies. It also undertakes applied research on behalf of corporate clients from across Canada and around the world. The ARC is also a host of specialized high-tech facilities:

- The Biotechnology Pilot Plant is a $10 million scale-up plant for pharmaceuticals and cultures. Researchers create large batches of their organisms (up to 35,000 litres) and get U.S. Federal Drug Administration Good Manufacturing Practice certifications.
- The Electronics Test Centre provides testing and safety certification for electronic products from domestic and international markets. These include product evaluation, failure analysis, as well as electromagnetic interference, cold weather and open field testing. Located at the ARCs Edmonton headquarters, the Electronics Test Centre allows companies to test their products in Alberta instead of eastern Canada.

The Alberta Research Council fermentation scale-up plant

Alberta Telecommunications Research Centre

Founded in 1986 as a nonprofit subsidiary of the University of Alberta, the Alberta Telecommunications Research Centre (ARTC) is today the model of infrastructural support provided in part by the government of Alberta. The Ministry of Technology, Research and Telecommunications provides about 30% of the centre's budget. The rest comes from industrial sponsors, including Bell Northern Research, AGT, `edmonton telephones,' NovAtel, Digital Equipment Corp., and L.S.I. Logic Corp.

The centre's mandate is to link academic research from the University of Alberta with private industry in a mutually beneficial effort. Industrial sponsors can use the products or processes without violating patents. And academics can commercialize their research in a well-funded atmosphere. Utilizing primarily scholars and graduate students from the U. of A., the centre keeps private industry on the cutting edge of telecommunications research.

The centre focuses on four areas of research: network access technology for better linking users to networks; advanced transmission technology for better, faster and more reliable digital systems; intelligent network technology for improved long distance networks; and circuit and software technology for automated systems. "We're not trying to be Bell Labs," says Dr. Michael Leung of ATRC "We're trying to pick niches we can make real progress in."

The Alberta Laser Institute

Founded in 1984 with a $5 million investment from Technology, Research and Telecommunications and a $1.5 million investment from the federal government, the Alberta Laser Institute is a one-of-a-kind facility in Canada. Its primary mandate is to introduce Alberta companies to laser technology and encourage them to use lasers in their manufacturing processes. The Institute's 17 staff members have expertise in laser materials processing (ie: welding, cutting, heating and clading) as well as optoelectronics and medical applications. It also has special expertise in laser metrology, which is the precision measurement and alignment of parts and equipment for manufacturers.

The Institute has a strong research and development component and will undertake research on a contract basis or as a cooperative effort. Prototypes can also be developed and tested at the Institute. The Edmonton facility has long boasted of a 1,000 watt laser and just this spring installed a new 1.6 kilowatt laser with a four-by eight foot cutting area. "Lasers are really a new technology in Alberta but they promise lots of advantages in many areas," says Dr. Don McKen, president and C.E.O. of the Institute.

Alberta Microelectronics Centre

Founded in 1982 with federal government aid, the Alberta Microelectronics Centre (AMC) was charged with aiding industry to utilize microelectronics in their products. The province came on board in 1986, and today the Centre designs and develops prototype ASIC (Application Specific Integrated Circuits) for consumer electronics, precision instrumentation, telecommunications, computers and digital signalling clients. (ASICs are computer chips and circuit boards custom made for specific tasks. The AMC will design and manufacture prototype and production models for clients.)

The Centre stresses solid business practices—clients pay for AMC design services—and works hard at raising awareness by holding seminars and educational sessions for Alberta business people. It also sponsors research projects at Alberta universities and helps train up-and-coming microelectronics specialists.

Inspecting wafer circuits at the Alberta Microelectronic Centre

Alberta Heritage Foundation for Medical Research

The AHFMR is the classic case of support for high-tech in Alberta. Born around the premier's dining room table in 1979, the Foundation uses a $300 million endowment from the Alberta government to make the province world-recognized for its medical research. Over $240 million has been given to over 200 doctors and 2,000 students to support their research and education. More than $58 million was spent building research facilities at Calgary and Edmonton hospitals. And still the initial fund has grown to $509 million. (The $300 million nest egg is never spent. By law, the Foundation only spends money accumulated through investment interest.)

All these millions have helped diabetes, lupus, and chlamydia patients, aided in finding heart, juvenile diabetes and high blood pressure drugs, helped a paralyzed man walk again—on and on it goes. The number of projects funded jumped over 1,000 last year and continues to grow.

Still moving the research from lab to a hospital bedside is difficult and the Foundation arranged a $9 million technology transfer program to help. Researchers can get $500,000 in phased grants to smooth the passage—which might include clinical trials for drugs or prototype testing for products.

Today Alberta is a world-recognized medical research centre and over 170 experts have been recruited from around the world to work in Alberta hospitals and universities. All this is possible because of the AHFMR◆

From Lab to Market

Commercializing Research from Alberta's Universities

Virtually every scientific advance the world has seen started in a university laboratory. D.N.A., the building block of life, was identified there. Man's journey to the moon started there. Computer technology was first probed there. The list goes on and on. Universities are so important, ignoring their contribution would be like trying to drive a car with no engine.

So it's no surprise that Alberta's three universities are crucial in making Alberta a high-tech province. Between them, the Universities of Alberta, Calgary and Lethbridge spent over $120 million on scientific research last year. It ranged from cutting edge work in medicine and biotechnology to the latest developments in lasers, electronics and telecommunications to probing the furthest reaches of mathematics.

Increasingly, however, Alberta educators have realized all these scientific leaps forward are pointless unless they are transferred into society. Universities must be less insular, more open to the commercial advantage their research creates. This takes two forms, contract research and technology transfer.

Contract research is applied work done on behalf of a company or agency. A scientist will complete a specific number of experiments and report the results back to the sponsor who has paid the costs. The company benefits because it's often cheaper than setting up its own lab and hiring researchers and the university benefits because its people gain experience and often delve into new areas. It's still a small component of university life—last year, for instance, the University of Alberta spent $66 million in all research areas and of that only $8 million was contracted—but it is expected to grow significantly in the next decade.

Technology transfer is just as small but it may have more potential. This involves transfering university research into the marketplace as a product or service. The university either licenses an existing company to sell the product or service and collects a royalty or it sets up a new company to do the same thing.

Alberta's two major universities take different approaches to commercializing research.

Intellectual Property and Contracts Office—University of Alberta

An arm of the Office of Research Services, the Intellectual Property and Contracts Office overses all contract research at the university. It also deals with such things as copyrights, patents and joint ventures. Founded in 1985, its eventual goal is to become self-sufficient through royalties and dividends, says Bill MacDonald of the office. That may take years, however, because there's little income at the moment. Even the most successful technology transfer program in Canada, at Queen's University, garnered only $325,000 last year. The most successful programs in the world, at Stanford and M.I.T., bring in about $10 million per year, hardly large sums in the grand scale of university funding.

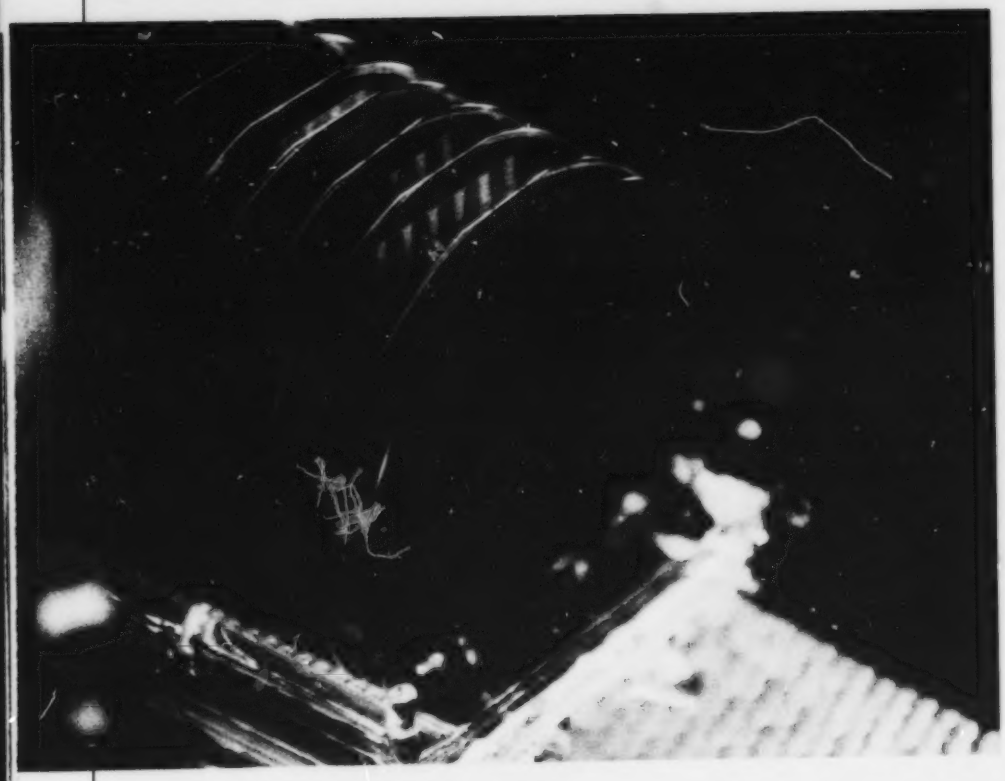
Still technology transfer is viewed with considerable importance by Bill MacDonald, the responsible officer. "Canada produces about 5% of the technology in the world," he says. "If Canadian companies are going to compete...they're going to have to bring on new technology. And the sources of new technology are inside their own doors, at the universities....."

University Technologies International Inc.—University of Calgary

In May, 1989, the University of Calgary set up University Technologies International Inc. (UTI), a wholly-owned subsidiary of the university. Its mandate is to make a profit through technology transfer. President John Fraser, an aggressive businessman, says he approaches his job with an "I'm-for-profit,-youre-for-profit.-Let's-do-a-deal!" attitude. It works. UTI has already licensed 12 products for manufacturing by outside companies and will likely do the same number in 1990. UTI will take a small royalty when the products start producing an income. In addition, five spin-off companies have been created and UTI owns equity in all of them and they may pay dividends some day, says Mr. Fraser.

The strong profit motive apparent at UTI is in stark contrast to the technology transfer office at the University of Alberta. Mr. Fraser says his attitude is one most corporations like. Many are uncomfortable dealing with university bureaucracy and would prefer to deal with another company. The corporate structure also allows Mr. Fraser to raise money outside the university for investment purposes. It also more plainly states the universities attitude towards technology transfer. "The point is to make money for the shareholder," he says, meaning the university.◆

Aids Research at U of C



Starting From Scratch

Growing a high-tech company is no easy matter. Sometimes they spring from the loins of a well-established company, already fully-financed and with a product ready for market. NovAtel is a good example of this phenomena. But more often companies start in an entrepreneur's basement or garage, as an idea in the back of his or her head. Getting from there to the full-blown accoutrement of a company, complete with a product, financing, salesmen, production line, support staff, payroll—on and on it goes—is horrendously difficult.

To ease the passage, various levels of government and industry have set up "business incubators." These work like incubators found in laboratories all around the province. In them, scientists control the temperature, humidity, air pressure, and a host of other variables. The point is to grow an organism under controlled circumstances. As might be expected, business incubators work in much the same manner. Conditions are created that encourage the growth of a company.

Fledgling entrepreneurs lease office space in one of the three incubators around the province (two in Calgary and the third in Edmonton) and set to work putting the finishing touches on their product and their company. Although the incubators don't include wet laboratories, tenants can use lab space elsewhere. Incubator management will help find it. The real focus of the incubators is business management. They help entrepreneurs put together business plans, find financing for the company, arrange introductions to investors and potential board members, help with prototype development and so on. Once all that is in place, the company moves to commercial space and it's on its own. The incubators provide crucial support at crucial times and often a new company is born.

What's really useful, however, is the atmosphere an incubator fosters. Fifteen tenants currently occupy offices at Discovery Place One, a Calgary incubator. They're working on everything from arctic engineering to custom computer software to solar powered water pumps. Says Cody Slater, president of B. and W. Technologies Ltd. and a former incubator tenant, "What really mattered was the atmosphere....We sort of fed off each other. If we needed help with a computer problem, it was just down the hall." He also points to the business professionalism that encouraged potential investors. "Rather than visiting us in a bay somewhere, they came to the incubator. It was simply more impressive," he says. Without that situation, he thinks, B. and W., a $7 million company, might never have gotten off the ground.

That's music to the ears of Bill Croft, president of the Calgary Research and Development Authority. He founded the first incubator in Alberta back in 1984 and runs Discovery Place One. "We don't profess to be a business school," he says, "but we're there when people need somebody to talk to. We try to treat tenants like grown-up business people, but we're a little more compassionate," he says.◆

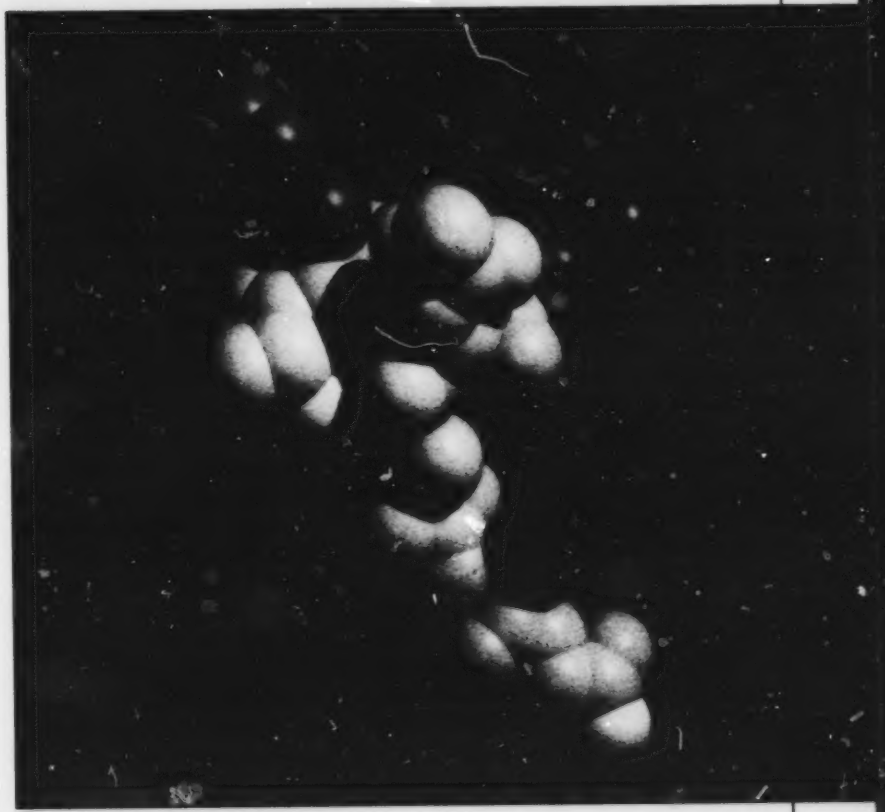
Education Unlocks the Future

"Young people aren't aware of the opportunities that exist [in high-tech]," says Technology, Research and Telecommunications Minister Fred Stewart. "They are moving into business administration, law and so forth. That's desirable, but at the same time there's just a dearth of people considering engineering and science as a career. I'm convinced they're just not aware of the opportunities that do exist and will exist in the future." That's why he has made awareness his number one goal for the first part of his mandate as minister.

The effort starts with television and print advertising campaign called "Science City." It notes that over 50,000 people are directly employed in technology-intensive industries in Alberta. Indirect jobs bring the total to 200,000. If all those people could be collected in a single place, it would be the third largest city in the province and the fastest growing city too. "You won't find Science City in your atlas, but it is putting Alberta on the map," reads one magazine ad. It's a clever campaign, but hardly all that Alberta is doing.

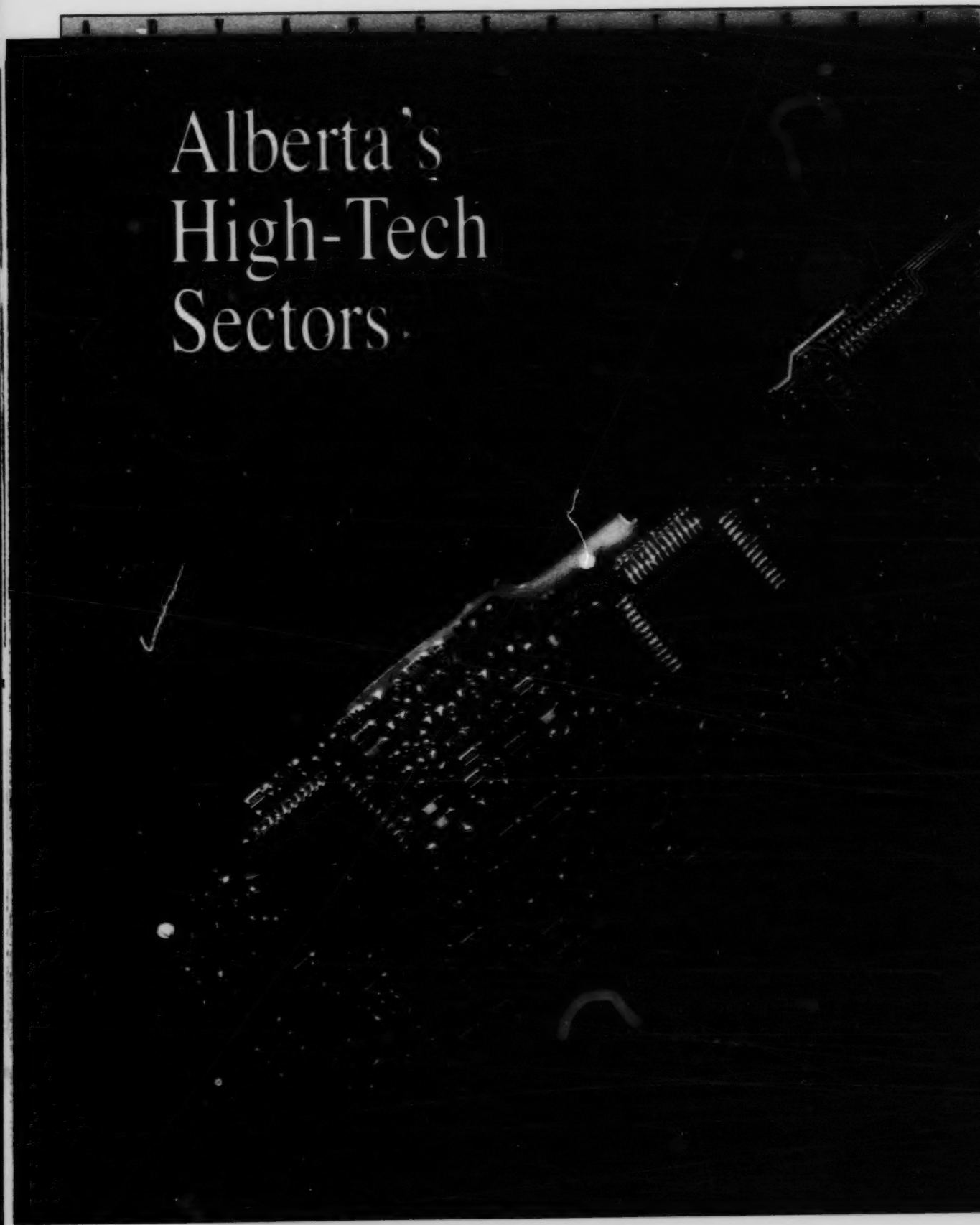
Students are the focus of most awareness projects across the province. Kids are being encouraged to view science as fun and exciting and as a possible career. "Letting students know about the possibilities of high-tech is the most important thing we can do," says Tony Myers, Director of Corporate and Public Relations with the Department of Technology, Research and Telecommunications. He points to a host of educational packages and videos teachers can get free of charge from his department. One video, "High on Technology" won a gold medal in the 1988 International Film and TV Festival of New York. "If we capture the imaginations of enough young people, maybe by the year 2000 industry will no longer have trouble finding qualified people," says Mr. Stewart.

The province also publishes a host of pamphlets, brochures and journals designed to raise the profile of advanced technology in Alberta. The high profile "Science City News" comes out quarterly and sector reports are updated on a frequent basis. Teachers, service clubs, girl guide and boy scout troupes, indeed everybody, are invited to call 422-0567 for information on how to access materials. They are available free of charge.◆



Alberta Universities concentrate on research

Alberta's High-Tech Sectors

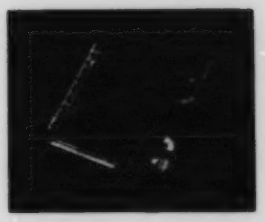


Communicating with the Future

TELECOMMUNICATIONS LEAD THE WAY

Telecommunications are the most developed of advanced technologies in Alberta. The province started sending signals in 1908 with the founding of Alberta Government Telephones (AGT). Today AGT has assets of $2.5 billion and services 1.6 million Albertans outside Edmonton. The 785,000 people of the provincial capital are serviced by their municipally-owned "edmonton telephones" with $438 million in assets. Together these two telecommunications carriers have a $1.3 billion annual income, the second largest system in Canada.

Still AGT and `ed. tel.' are service companies. They string the fibre-optic wires and beam the microwaves for Albertans. Their commitment to research and development is rather limited. That's left to about 200 other companies which design and build everything from massively complex digital switching equipment to the most advanced cellular phone networks in the world to explosion-proof phones. Under the cluster concept, the two leading companies are Northern Telecom Canada Ltd. and NovAtel Communications Ltd.



Northern Telecom is the gigantic multinational (47,000 employees worldwide and $6 billion U.S. in revenue last year) with headquarters in Toronto and Nashville, Tennessee. One of the company's two Calgary manufacturing plants produces the Meridan line of business phones. Retooled to handle this product just two years ago, the plant has since sold over one million of the sets in 40 countries. Although the system was designed at the company's research arm, Bell Northern Research in Ontario, Doug Noble, director of public affairs for western Canada, says numerous innovations have been suggested and implemented by workers on the assembly line in Calgary. Just two years ago, the line

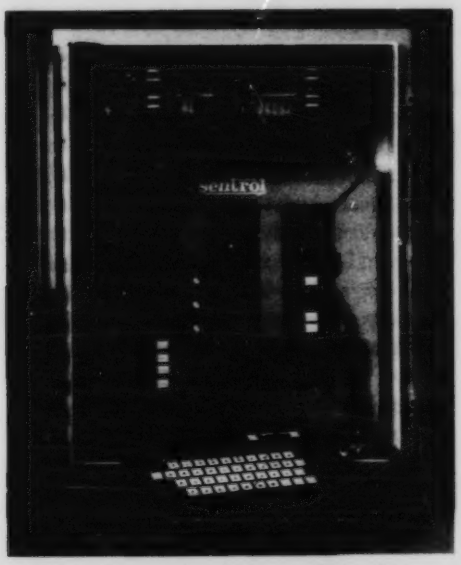
kept busy 385 people. Now it keeps over 600 running in three shifts. The plant wouldn't be competitive with similar plants in Asia (where the cost of labour is dramatically lower), except for automation of the assembly line two years ago. Today much of the precise work of fixing computer chips to circuit boards is done by laser-guided robots. "We simply couldn't compete without the automation," says Mr. Doug Noble.

The second Northern Telecom plant in Calgary manufactures the DMS (digital multiplex system) family of switches. These mid-sized systems can handle between 300 and 100,000 local and long-distance subscribers in refined areas and have been sold to AGT and throughout North America, the Caribbean, the Pacific Rim and Europe. Altogether Northern Telecom's two plants and regional office in Edmonton employ 1,100 Albertans and buoy the economy with a $43 million payroll. Quite simply, it's the largest high tech company in Alberta.

Not far behind and gaining fast is NovAtel Communications Ltd. Founded just seven years ago, it sold almost $300 million in cellular phones, equipment and services last year. World headquarters are in Calgary and manufacturing plants work in Calgary and Lethbridge. NovAtel has taken on the telecommunications industry giants, Motorola, Panasonic, N.E.C., Toshiba, Mitsubishi and others and won 25% of the U.S. market and 13.3% of the world market for cellular communications. "That's simply amazing," says Bill Croft of the Calgary Research and Development Authority. Indeed, it makes NovAtel the single most successful high tech company in the province.

Cellular communications are essentially radio communications without the glitches. Suppose you place a telephone call from your desk to a cellular phone. The signal travels the regular wire system and switches like any office-to-office call. But then it is sent to a radio transmitter strategically located in your area. Converted into a radio signal, it is beamed to the receiver's location, his phone rings and conversation ensues. The advantage of cellular over conventional radio is the number of frequencies. Typical cellular transmitters use 1,200 frequencies to send and receive; old style radio used one. Thus every call is private. Furthermore old style radio was one-way. That is, you could either receive or transmit, but not both at the same time. Cellular allows simultaneous transmission and receiving because two frequencies are used, one to transmit, another to receive, and then they are blended in the phone or switch. A cellular call sounds and feels just like a regular land line call.

While this gives tremendous advantages to the consumer, it has even more potential in the third world. On the island of Mauritius in the Indian Ocean, for instance, NovAtel installed a cellular network that effectively bypasses the land lines. Rather than stringing fibre optic cables across 720 square miles of territory, the nation installed a NovAtel cellular system. "We literally covered the island in cellular," says Arunas Slekys, senior vice-president Research and Development at NovAtel. The capital cost of Mauritius was much lower and they have the same level of service, if not better, than



traditional ground techniques. China has taken similar leaps ahead of the first world with NovAtel networks in Chongqing and elsewhere.

Still cellular technology is new and bugs continue to plague the systems. Late last year, the company developed new technology to handle problems where two dissimilar cellular networks butt up to each other. At these points, phone calls went dead as a car moved from one network area to the other. This was solved when NovAtel and Northern Telecom developed the first commercial "hand-off" system in the world. Using the Edmonton region where AGT and `ed. tel.' collide, the hand-off software allows calls to move between systems with no break in transmission. The area is now "seamless" and NovAtel is offering the technology to cellular network operators around the world.

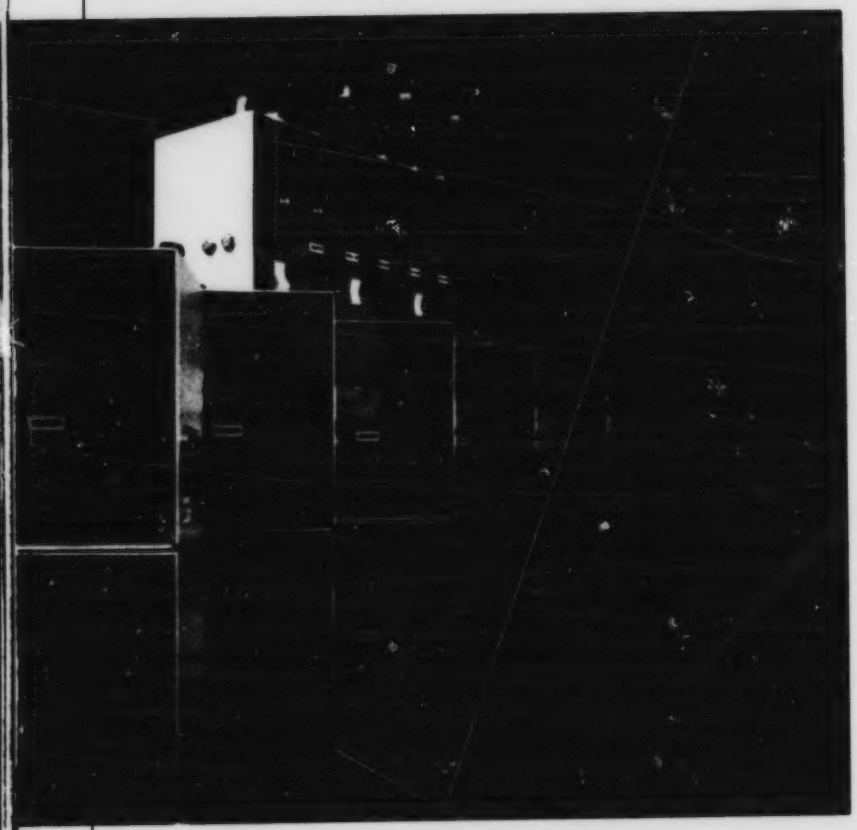
It's new developments like that which keep NovAtel ahead of the competition. The company spends millions every year on research, including investment in the Alberta Telecommunications Research Centre in Edmonton. Still, in the high flying world of telecommunications, research and development is the only way to stay competitive. NovAtel was founded with such uppermost in management's mind. It's a promise they plan to keep.◆

Dick Tracy Wristwatches

Remember the comic strip and movie starring Dick Tracy, the upright police detective famous for his wristwatch phone? Whenever there was trouble, Tracy hit a switch on his watch and called for help. Back in the 1950s, it was a nice fantasy. Tomorrow it'll be reality.

At least that's the vision of Dr. Arunas Slekys, senior vice president research and development at NovAtel. He has the enviable task of plotting the future of cellular communications. Thinking 20 years into the future is a task he tackles with glee. "Soon you'll be able to receive a satellite signal and determine your exact position to within about twenty metres," he chortles. More precise instruments will give locations to within a centimetre. The possibilities for such uses are endless. Ship, airplane, even car navigation will be a matter of pushing buttons, not consulting charts. Thieves will find the police on their doorstep when a cellular transmitter informs them of the stolen car's location. Fleet managers will be able to locate their taxis and couriers with a moment's notice. Surveyors will point their instruments at satellites instead of at sticks in the ground.

In office buildings, those annoying pink telephone message slips will disappear with advent of PBX (public branch exchange). When workers step away from their desk, they'll carry a beeper-like device warning them of incoming calls and they'll take the call then and there. All these developments will be possible through cellular and no doubt more are on the way. "Information flow is economically important, even more so than the goods themselves," says Dr. Slekys. That's the information society knocking on the door again. And when cellular technology can be miniaturized sufficiently to fit into a wristwatch *a la* Dick Tracy (about 10 years from now), Alberta will riding the crest of the wave.◆



It Starts with Electronics

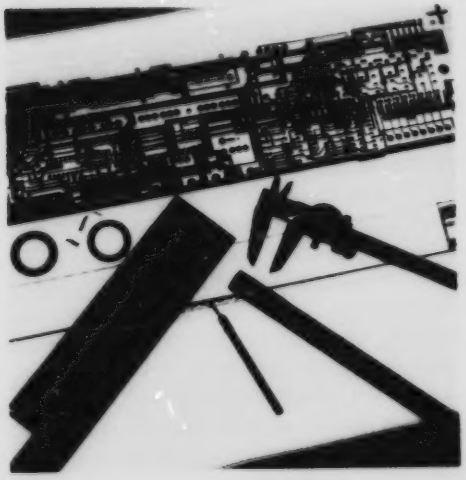
FOUNDATIONS

Everything Alberta is trying to do with advanced technology starts with electronics. Computers, lasers and telecommunications obviously require electronics. But even medicine and biotechnology are nonstarters without the advanced electrical equipment of computers, microprocessors, incubators and so on. Few Alberta high-tech companies would be anywhere without electronics, and increasingly many of those products are being made right here in Alberta.

Still the industry is in its infancy and the cluster concept is barely stirring. There's really no leading company pointing the way and eating up product from smaller companies. NovAtel and Northern Telecom use huge quantities of electronic equipment and perhaps they come closest. But in terms of pure electronics, perhaps only L.S.I. Logic Corp. of Canada can claim the mantle.

L.S.I. is the Canadian subsidiary of a large American electronics company of the same name. Several years ago, the Alberta government convinced L.S.I. to become involved in a pilot ASIC (application specific integrated circuits) and computer chip manufacturing plant at the University of Alberta. The experimental plant was then very small but L.S.I. became involved because it promised new technology for its ASIC and chip manufacturing plants in the U.S. Things worked out a little differently, however, when L.S.I. spotted a large niche in the Canadian market. It decided to set up a large scale ASIC and chip manufacturing plant and with help from the province and the university, it did just that last year. Today, L.S.I. supplies about 75% to 80% of the Canadian market in ASICs (it shipped 200,000 of them in the final quarter of 1989 alone) and had sales last year of $33 million. According to some predictions, the Canadian market could be worth $100 million in five years. Obviously, there's room for growth here.

L.S.I. Canada spotted a similar opportunity in South Korea and set up a wholly-owned subsidiary to service the growing South Korean demand for computer chips and ASICs. South Korea is, of course, an emerging giant in consumer electronics and automobiles and chips are a major component in those fields. So even though L.S.I. hasn't shown a profit for several years, the company is on the verge of becoming very large indeed.◆



ARCHER DEFIES THE CRITICS

3-D Sound Comes Around

One doesn't need a university education to take bold new leaps in science, at least that's the message of Dan Lowe and John Lees. They're the geniuses behind Archer Communications and "QSound," the once-controversial company and product that creates 3-D sound. Lowe, a record producer, had stumbled upon the sensation while experimenting with 14 microphones in a Calgary recording studio. Intrigued, he demonstrated it to Lees, a studio electronics expert, and the two set off on a 10 year quest to capture the sound.

They eventually linked up with Calgary financier Larry Ryckman and he arranged capital investments through Archer Communications, a shell company listed on the Vancouver Stock Exchange.

The two inventors' problem was transferring the sound of 14 strategically placed microphones into a usable product. Their experimenting with sound wave propagation helped out, but they wound up delving into the workings of the inner ear and how the mind recognizes sound. And neither had any formal education in physics, let alone medicine! They simply went to work and trod new ground when their research showed they had to. Most scientists were openly sceptical of both their theories and their methods. Creating 3-D sound was supposedly impossible according to the laws of physics.

No matter. Lowe and Lees went to work and last winter unveiled their sound in a Coca-Cola commercial during the Superbowl. They also sold the sound, now packaged into a small black box that can be attached to recording equipment, to Nintendo Corp. for $3 million in upfront royalties plus a per-product fee. Not bad for a couple of studio technicians from Calgary!✦

SCIENTIFIC ENTREPRENEUR

Sniffing Out Poisonous Gas

Five years ago, Cody Slater was paying his way through university cutting lawns. Today his booming little high-tech company, B. and W. Technologies, sells $7 million worth of poisonous gas detectors. Mr. Slater's products—dubbed "rats" after the rodents used like canaries to warn miners of poisonous gases—detect H2-S, CO2, CO, C12, H2, NO, NO2 and O2. The real culprit, however, is H2-S, known as "sour gas" and deadly enough to kill in 30 seconds. Mr. Slater's rats sound warnings of gas leaks in nine seconds, leaving workers time to flee. So far, most rats have gone up near sour gas plants, pipelines and batteries, and one system was installed at a lumber mill.

In many ways, Cody Slater is the model scientific entrepreneur the Alberta government is striving to support. B. and W. spent a year in the Calgary Research and Development Authority incubator. "Its biggest value," he says, "was atmosphere." The other tenants and the administrators provided incentive to keep working and keep trying. At the same time, and to this day, Mr. Slater was constantly referring to the Alberta Research Council libraries in Edmonton and Calgary. "They don't tell you how to build something, but they do tell you where to look," he says. They are "tremendous things." And once his systems were into prototype, the Electronics Test Centre opened its doors and labs to certify them as safe. Certification is an ongoing process and the "Shack-Rat" will soon acquire "intrinsically safe" status. That means the systems will not in themselves cause a fire and therefore the packaging can be changed. Currently, the rat line is cased in heavy steel at a cost of about $170 per unit. Once labelled intrinsically safe, they can be housed in plastic at a cost of about $9 per unit. The savings will only make B. and W. more competitive.

Still Mr. Slater hasn't stopped with gas detection. In conjunction with Dr. Sheldon Roth, a toxicologist from the U. of C., he has plans to

launch the "Envirosphere" later this year. Developed by Dr. Roth in his U. of C. lab, the envirosphere is a controlled atmosphere. Researchers, or more likely high school students, can manipulate variables like temperature, humidity, acidity and so on and watch the effects on plants and organisms growing in the apparatus. The point is a very visual demonstration of the devastation of the greenhouse effect. Plenty of mock-atmospheres exist in university labs around the world, but they are $40,000 behemoths. Roth's version will run about $800 and hopefully school boards everywhere will buy them.

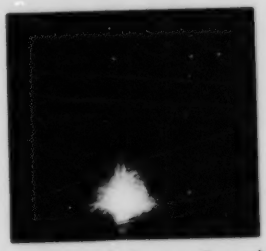
B. and W.'s core business is still toxic gas detection, however, and the company spends about 10% of annual revenue on research and development. New products on the drawing board include a personal gas detector that may have tremendous use in mines and closed spaces. It will, among other things, sound when oxygen depletion gets dangerously high, warning workers to seek air no matter the flavor of the invading gas. Other ideas are stewing in entrepreneur Slaters fertile mind, but he won't divulge the secrets. He does happily speak to his ambitions for B. and W.: "Environmental technology is where consumer electronics was 30 years ago. Back then nobody had heard of Sony," he says. "In the next few years, some stars are going to emerge and I want B. and W. to be one of those corporations."◆

Lasers May Light the Way

Most everybody is familiar with lasers, even if they don't know it. Lasers read bar codes at grocery stores and input prices into cash registers. They are the basic technology behind compact disk players and almost everybody has seen a laser light show. Increasingly lasers are showing up in surgical theatres, burning cancerous growths without damaging the organs underneath. There's even talk of turning lasers into weapons with the Strategic Defense Initiative, better known as Star Wars. Weapons may be a little far out, but in Alberta a fledgling laser industry is firing into existence.

By far the most advanced system is being developed at General Systems Research. GSR is the high-tech company that went bankrupt in a blaze of publicity earlier this year. The company was designing and manufacturing a laser system for the garment industry which promised to save time, material and money for the buyers. Unfortunately not enough buyers came forward in time, and the huge costs of researching and developing the laser overwhelmed the company's finances. The company, however, is still operating and the garment laser research and development will carry forward in a new company.

Other companies are also active in the field. Aurora Bar Code Technologies Ltd., for instance, sells low intensity lasers to AGT, Videotron, and universities across the West. Their best-selling products incorporate "keyless data entry technology" and miniaturization. That is, hand held computers that don't include normal keyboards, but rather laser-reading devices for bar codes. "Salesmen, engineers, drivers and so on use the devices in the field, then enter the data into the mainframe back at the office," explains Aurora president Lan Bowden. His company does little research and development work, it buys the products in Japan and sells them to Albertans. That's pretty much the way the entire laser industry in Alberta works. Local companies buy the devices and resell them for use in Alberta. Indeed, introducing the laser into more workplaces is one of the main jobs of the Alberta Laser Institute. "We try to introduce indigenous industry to the new technology," says Laser Institute president Don McKen. "We help local Alberta businesses identify opportunities to use lasers in their product manufacturing," he says. Still there's plenty of room for laser research and development and efforts are underway to grow more laser companies here in Alberta.◆



Alberta Goes to Space

INTERA SEES PROFITS FROM SATELLITES

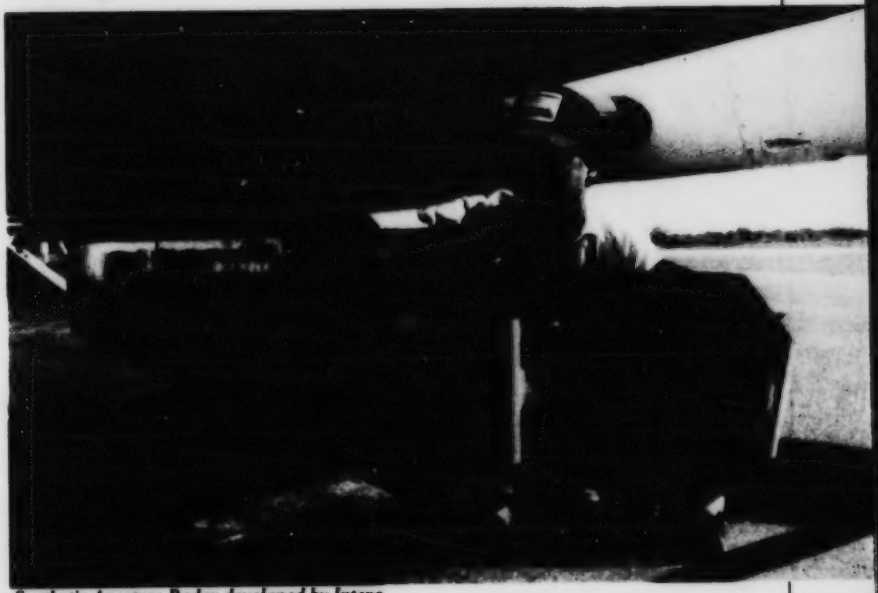
Intera Information Technologies Corp. of Calgary is about to lead Alberta into space. In 1994, NASA will launch the $440 million RADARSAT satellite and Intera and three partners have an exclusive worldwide licence to sell all the data the satellite generates. Equipped with the most sophisticated synthetic aperture radar in the world, RADARSAT will spend five years bombarding the earth with cloud-piercing radar and beaming the results back to Intera. The resulting images, as clear as any black and white photograph, will tell clients about rainforest depletion in Brazil, ice flow conditions in the Arctic, grain crop yields in Russia and China, and fishing ships along coast lines. Indeed, if something sits on the earth's surface, RADARSAT can photograph it and Intera technicians can interpret it.

Intera and its partners won this lucrative licensing contract from the Canadian Space Agency and is pre-selling the data to countries like Costa Rica. "There's no way they could afford to put up their own satellite," says Intera president and chief executive officer Brian Bullock. "But they can afford to buy data of their own country from a satellite that's already in orbit." Although it's too early to give firm figures on the potential revenues from RADARSAT, Mr. Bullock says the space satellite market is worth a billion dollars annually. To win the RADARSAT licence, Intera put up about $2 million. "That's not bad," says Bullock.

And the Calgary-based company isn't stopping there. It is one of the leading private sector partners in the Earth Environment Space Initiative (EESI), a drawing board concept to launch another satellite in the late 1990s. The four western provinces signed on and committed $1.4 million to a feasibility study. Said Alberta's Minister of Technology, Research and Telecommunications, Fred Stewart at the time, "We've achieved a real spirit of cooperation among the western provinces in advancing science and technology. Today's event [signing the agreement] is tangible evidence of this."

Intera's role in EESI will likely involve developing the synthetic aperture radar (SAR) the satellite will use to "see" the earth. The company was the first to commercialize SAR when it installed the technology aboard jets in the 1980s. (Previously, SAR had been used by the superpowers to spy on each other.) Intera put it to more peaceful use by mapping ice floes and land formations and selling the pictures to industry and governments. It compiled, for instance, a complete aerial map of Sumatra in a few months using SAR Conventional air photo techniques would have taken years to do the job and Intera's pictures were as good if not better.

And now with the environment such a hot issue, Intera and the province of Alberta are making it a top priority with EESI "[Environmental monitoring] is an activity that Canada can show some leadership in. A space station? We don't have the economy to support something like that. [But] with environmental monitoring, Canada has the wherewithal in terms of technology and resource management expertise to be a global leader. We can be a model of an environmentally conscious nation," says Mr. Bullock.◆



Synthetic Aperture Radar developed by Intera

Niche Markets

ALBERTA COMPUTER COMPANIES SEEK THEIR LEVEL

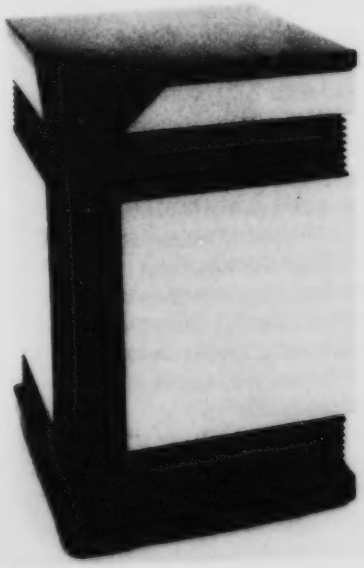
Two issues have dominated the computer industry since its inception: miniaturization and speed. Making computer hardware smaller was largely achieved with the advent of the computer chip. Making computers faster is still an ongoing effort and researchers in Alberta are in the thick of the race. For reasons that can be traced back to the founding of the computer science faculty at the University of Calgary, Alberta has developed a real specialty in parallel computing and simulation. Many of the researchers who joined the faculty had a background or interest in these fields and today Alberta is recognized as a world centre for simulation and parallel computing. In fact the Summer Computer Simulation Conference, an international conference of all the big shots in the simulation world, will be held in Calgary in July.

The leading light in Alberta's computer technology world is Myrias Research Corp. of Edmonton. Founded in December, 1982, Myrias spent its first six years developing the S.P.S.-2 supercomputer. So far the Pentagon and the Canadian Department of National Defense have bought the $1.5 million machines, and the Alberta Research Council and University of Calgary are borrowing models.

What makes the S.P.S.-2 special—and the coming S.P.S.-3—is the immensity of its parallel computing function. Parallel computing is essentially lining up several computers and having them work on a single problem simultaneously. For example, if a researcher has a problem that requires 1000 hours of computer time, he might be able to use a thousand computers in parallel and complete the task in just one hour. At least that's the theory. In, it's much more difficult. Convincing one hundred computers to work together on a problem is exceptionally difficult and takes years of hardware and software development.

That didn't stop Myrias from trying, however, and in 1987 it installed its first computer at the Alberta Research Council. That was an event for cheering all around because Myrias had spent years consuming research dollars, $20 million to date and counting. Of that sum, $10 million is taxpayers' money invested through Vencap and the Alberta Opportunity Company. "In a Canadian context, those numbers may seem huge," says Jim Fletcher, vice-president finance at Myrias. "But in U.S. computer start-ups there's typically $40 to $60 million invested before reaching cash positive positions. [Myrias] is a big investment in Canada, but in international terms, it's really quite modest," he says.

None of that may matter by this time next year however. Myrias is set to launch the S.P.S.-3 in the fall and indications are sales will be strong. The S.P.S.-3 is the next generation computer from Myrias and it promises to run ten times faster than the older version. Ironically, developing the S.P.S,-3 has hurt Myrias' sales. "People know we've got something new coming shortly and they tend not to write cheques for something old," says Fletcher. He thinks the new product will generate in excess of $100 million in sales over the next three years and that kind of money will certainly make Myrias profitable.❖



Myrias Computer

SIMULATING DISCREET EVENTS

Jade Sees the Future

Myrias isn't the only big name parallel computing company in Alberta. Jade Simulations International Corp. of Calgary is taking a lead position in world markets with its advanced simulation software. The company, led by University of Calgary computer scientist Brian Unger, works at improving the communicating ability of parallel computer processors. If, for instance, one processor is idle, it must be programmed to alert operators so they can use the power. In other cases, one processor will be reliant on another processor's solution and it must be programmed to assume an answer and solve its assigned task on a hypothetical basis. If the assumed solution is in fact correct, then considerable time has been saved and the computer has done its job. If the assumed solution turns out inaccurate, then the second processor must start again and no time has been saved. But the risk is worth taking.

All of this, as you might expect, takes exceptionally sophisticated software, and Jade was founded in January 1988 to seek it out. Now staffed by 30 specialists, the company is still largely concerned with research and development. But customers are already lining up at its door for the world-class expertise Jade offers. Hughes Canada, for example, is a subsidiary of one of the largest defense contractors in the U.S. and it needs Jade technology to build its $380 million Canadian Automated Air Traffic System. Jade's computers will help simulate the flight paths and landing sequences of hundreds of airliners across Canada, work that will help Hughes engineers with their design work. Other Jade clients include AGT, the Canadian airframe and the U.S. navy. Jade may not be a super-profitable company right now, but if the Hughes contract pays off, Jade is poised to become the dominant player in the parallel computing world.◆

HOW ALBERTA RATES IN SOFTWARE DEVELOPMENT.

A World Perspective

That's the message carried by Steve Madsen on his journey from Detroit to Edmonton. He recently quit his job at the largest software development firm in the world to join a little ten-year-old company in Edmonton, Computronix Holdings Ltd. The differences couldn't be more startling. E.D.S., a General Motors subsidiary, has 56,000 employees and the greatest concentration of software specialists in the world. But it was no more advanced than Computronix and in some ways the little Alberta company was way out in front. "Coming from Detroit, I found Alberta [software] developers to be very advanced....The smaller you are, the more reactive you can be to new technologies," says Mr. Madsen.

New developments at a huge company like E.D.S. are forced through layers and layers of bureaucracy and management committees before approval is given. Little companies can make the decision almost instantly and implement the ideas without delay. It's like arranging renovations to a house you own compared to an apartment you rent, says Madsen. If you own the house, change can be implemented without much problem. That's not true of apartments.

Thus Computronix was recently able to sell a database system and associated software to the Northwest Territories Department of Health. The system allows computer illiterate managers to call up data on the computer without reference to computer programmers or specialists. "The computer software industry today is at a critical juncture. Computers are increasing in numbers and capabilities at a dramatic rate. But the software which provides the 'human interface' is years behind. Here is where the next revolution will occur," he says.◆

Hard vs Soft

Sometimes the difference between computer hardware and computer software is misunderstood. Hardware is the physical equipment, the machines that crowd people's desks around the world. These include keyboards, video display terminals, disk drives, modems, main frames and supercomputers. Software is the stuff that makes the machines work. It's usually contained on computer disks and called a "program." Separately, hardware and software are useless. You can't do anything with them. Together hardware and software make a unit that has virtually unlimited potential. Think of a hi-fi stereo. The hardware is the record player, the software is the actual record itself. Apart they have no use. But place the record on the record player, turn it on and suddenly you have music. Together the two separate units make something greater than their whole. Computers work under a similar principle. Combine the hardware and software and you have something that works.

The problem with computer research and development, then, is understanding what side is being pursued. Most Alberta companies are pursuing software developments, few see opportunities in hardware. The reason is that improving software, known as "programming," has tremendous potential and even entrepreneurs working on their basement machines can achieve success. Students in Alberta high schools do low level programming. Improving hardware, however, is a game for the I.B.Ms and Apples of the world, the huge companies with limitless cash and plenty of time. Only they have the resources to improve hardware.◆

Networking for the Future

Bob Blackshaw's company, Keyword Office Technologies Ltd. of Calgary has twice won Export Achievement Awards and twice garnered Electronics Industry Association of Alberta citations as "Company of the Year." So it's no surprise his high profile paid off with his election as Chairman of the Canadian Advanced Technology Association (CATA) for 1990.

In 1978, Blackshaw and a partner founded Keyword to research and develop integrated office systems for document interchange among computers. It's an unfortunate fact that many computers cannot talk to each other (they are not "compatible") and Keyword set out to develop translation software. It took six years to ship the first program, but now executives with IBMs and Apples can send electronic mail without producing plain gibberish. Fifty percent owned by Trans Alta Resources, the diversification arm of Trans Alta Utilities, Keyword is expecting to do $100 million in business in the next five years.

Mr. Blackshaw, then, is well placed to comment on high-tech in Canada, and he doesn't like all that he sees. "If you have money in Canada, you might as well buy a McDonald's franchise. Buy a sure thing. Don't bother with anything risky," he says facetiously of the inherent high risk of advanced technology.

That's why he's so convinced that CATA and organizations like it are necessary for high-tech to prosper. CATA has almost 400 corporate members and provides networking opportunities and business seminars on everything from global marketing to dealing with bureaucrats. It also acts as a lobby group for the industry. But perhaps most importantly, CATA has a public education role, and Blackshaw plans to pursue that task ahead of most others.

"As a nation, do we have the vision that science and technology are the most important things?" he asks. The answer isn't always clear, he says, and education is the first step. That's why he installed the western regional office of CATA in Keyword's building and is planning to hold news conferences there when science and technology events make the news. That may mean criticizing government when necessary, he promises, but it also means raising a cheer when appropriate.◆

Marrying Science and Business

DR. BOB CHURCH AS SCIENTIFIC ENTREPRENEUR

An executive suite is often foreign territory to many scientists. They typically spend their entire working lives in laboratories and classrooms. But many scientists have to adapt to the new circumstances if they want to commercialize research. It can be a troubling, even disastrous, experience. But Alberta scientists have a role model, Dr. Bob Church of Calgary. He is both a world-recognized scholar and successful entrepreneur, equally at home in lab and board room.

Dr. Church's list of accomplishments starts with Alberta Livestock Transplants Ltd., a company he co-founded in 1971 and the first commercial enterprise of its kind in the world. He stayed with the company through its transformation into Alta Genetics and was instrumental in the first commercial cloning of cattle.

In the meantime, he rose to the top of the Calgary Exhibition and Stampede Board, one of Alberta's largest tourist draws. And last year he tried to buy Connaught Biosciences Inc. of Toronto, the company created when Best and Banting discovered insulin. (His company, ExtraCare Corp., was beat out by a French company offering $940 million.) That didn't stop him, however, and he recently bought Biostar Inc., a seller of animal health vaccines, from the University of Saskatchewan.

Dr. Church thinks biotechnology in Canada is coming to a crossroads. There's currently several hundred little firms developing new products for world markets. Most, he says, won't survive in their present form. They'll wind up merging into larger entities or being bought out. That's not necessarily bad. A little 10-year-old New York firm recently sold for $250 million, which is big money in anybody's book. But it is not necessarily good either. Smaller firms tend to be more innovative, more willing to take big risks. A recent survey found 76% of new product development is taking place in small companies. If they are bought out or merged, some of that edge might be lost.

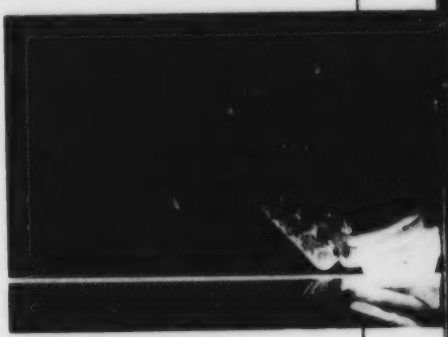
What Canada needs, says Dr. Church, is more "patient money," the kind that is willing to wait 10 years for a return. Canada also needs deep pockets. For every dollar spent on research and development, he says, about $100 must be spent getting the product to market. "There are market niches and major new developments we can enter, but not alot of these companies are going to succeed," he says.

Improving Nature

ALBERTA'S BIOTECHNOLOGY FIRMS ARE GROWING A BETTER FUTURE

Biotechnology will probably affect the lives of more Albertans than any other scientific endeavor. That's because it delves into the very heart of life itself, matching technology and biology to change living organisms in ways too numerous to list. But whether in the hospital receiving the very latest cancer drugs or eating beef improved by gene manipulation or walking through fields free of chemical pesticides, Albertans should understand biotechnology is the science of the twenty-first century.

The growth spurt is already starting to happen. Canada's 220 biotechnology firms are looking to hire over 5000 new employees in the next two years and spend over $1.4 billion on new manufacturing facilities alone. Alberta is right in the thick of the race, with almost 20 top level companies involved in research and development, over 125 of the world's best scientists working in her universities and the finest infrastructure support of any province in Canada. The sector is usually divided into two fields as shown on the following pages.



Human Health

Perhaps the most important area of biotechnology, the human health industry is based upon the research done at Alberta's two medical schools and associated clinics. Supported primarily by the Alberta Heritage Foundation for Medical Research, about 200 Alberta doctors are trying to prevent failing health, whether cancer, AIDS, diabetes, Parkinson's disease and a host of other killers. Their research has led to a wide variety of treatments.

Among the most notable researcher is Dr. George Wyse, whose University of Calgary Cardiac Group is studying the condition of arrhythmias. Essentially the rapid and irregular beating of the heart, the condition leads to some of the 30,000 heart attacks every year in Canada. Dr. Wyse's team has pioneered new drugs for controlling the condition and is working towards identifying those arrhythmia sufferers who are likely to have heart attacks.

Another team at the University of Alberta has developed a surgical technique that allows paralyzed patients to walk again. Developed by Dr. Arthur Prochazka, the treatment is similar to that used by pacemakers. A man-made electrical current stimulates the muscle left unmovable by accident or disease. A thin wire electrode is implanted in the leg and is attached to a battery pack worn at the hip. Sensors in the heel of the good leg tell the batteries when to send current into the bad leg, and the leg is stimulated to move.

Equally exciting is the work being done by Alberta human health companies. Founded in 1985 by two University of Alberta physicians, Biomira Inc. has developed diagnostic kits for cancer detection and sold them around the world. Its four products can detect gastrointestinal, ovarian, breast and prostate cancers, and chart a patient's progress through treatment. The products work by attaching themselves to cancer cells while ignoring healthy cells. Doctors can then piggy-back various signallers onto the products and watch them congregate on the tumor.

Similar techniques are under development for in vitro testing for lung, breast and prostate cancers and a new technique for sending medicines directly to the tumor while leaving healthy tissue alone.

Initial work on these ideas was done by Drs. Tony Noujaim and Michael Longenecker at the University of Alberta. They transfered the technology to Biomira with investment from Altamira Capital Corp., a venture capital fund, and money raised on the Alberta, Montreal and Toronto stock exchanges. The University also owns Biomira stock and receives a royalty on sales.

Chembiomed Ltd. also started on the University of Alberta campus and was later transferred into a commercial venture. It was founded in 1977 to commercially exploit the work of Dr. Raymond Lemieux, a world renowned scientist and the first person to ever synthesize sugar. His synthesis work has led to numerous products sold around the world. Among them is Syntype, a patented reagent used for blood typing, Synsorb, a family of drugs that cleanse blood of unwanted antibodies, and syntagen, a synthetic carbohydrate sold to other researchers.

Perhaps most importantly, Chembiomed

produces biosynorb, a group of drugs used in organ transplant surgery. It's used when donor and recipient have different blood types, a complication that used to make some transplant surgery impossible.

Agriculture

The province's animal and plant biotechnology industry is led by Alta Genetics Inc. Founded by far-seeing researchers from the University of Calgary as Alberta Livestock Transplants Ltd., it was the first company in the world dedicated to commercial embryo transplants in cattle. It has since developed some of the most advanced embryo transfer techniques in the world and today it can produce over 10,000 frozen embryos every year. (In this procedure, embryos from superior cattle are frozen for shipment overseas. Then they are implanted in surrogate cows and the buyer has an instantly improved herd.) That's why the Soviet Union signed a joint venture agreement with Alta Genetics, the first such deal with a Canadian biotechnology firm.

But Alta Genetics didn't stop there. Chief researcher Stein Willadsen was the first scientist to clone cattle in a commercial setting and is today working on business applications for the procedure. It's an exciting area because with cloning, scientists can produce better herds of cattle with less and less work. Already consumers are demanding less fat in their beef and Alta Genetics' cloning procedure might just deliver. Says Dr. Bob Church, a consultant to Alta Genetics, "Alta Genetics has made southern Alberta the stock capital for cattle in the world."

Other Alberta firms are doing work just as important. BioTechnica Canada Inc., for example, developed a product for inhibiting mold growth in hay and acid production in silage, two positive developments farmers have been snapping up. BioTechnica, founded as a subsidiary of BioTechnica International Inc. of Boston, ran into severe financial difficulties, however, and sold the product.

It now concentrates on a project designed to turn flax oil, also known as linseed oil and commonly used in paints and varnishes, into an edible oil. If successful, BioTechnica scientists will genetically manipulate flax to make it more like corn oil. If so, BioTechnica will enter a $2.6 billion market for crushed oils. Best yet, Canadian farmers can grow flax.◆

An Interview with the Minister

Technology, Research and Telecommunications Minister Fred A. Stewart explains how advanced technology will take Alberta into the 21st century

THE FUTURE BELONGS TO ADVANCED TECHNOLOGY

Ministers Opening Statement: Advanced technologies are moming ahead in the province, the opportunities that exist and the spin-off benefits are tremendous.

We have a bright future ahead of us. Advanced technologies will play a most significant role as we further the economic diversification of the provincial economy.

I am pleased to have the opportunity to play a small part in helping to build the momentum we need to compete globally during this decade and beyond.

Q: You've said the future belongs to advanced technology. What do you mean?

A: I say that because most of the value-added products and processes in the '90s will be based on technological developments and discoveries.

My department, Technology,Research and Telecommunications, is an economic portfolio. We are in the business of creating economic growth. We do it by encouraging the development of advanced technology manufacturing in Alberta.

To maintain the standard of living and quality of life Albertans have come to expect, science and technology discoveries have to be developed and manufactured in Alberta.

If we manufacture here, we create wealth here.

Q: If we are to succeed in the global competition for manufacturing in advanced technology, our R&D has to be globally competitive. Are we doing enough?

A: How could I ever say we are doing enough? What we are doing in Alberta is investing more dollars per capita in R&D than any other province in the country.

But, I think business and industry would agree we need to make more effective use of our R&D dollars. We need to concentrate on Market-driven applied research, and we must commercialize those ideas. The alternative is to allow those ideas to be developed elsewhere, to allow jobs to go to other jurisdictions, and to allow economic diversification to slip from our grasp. The alternative is not a choice that appeals to me.

Q: What is being done to accelerate the momentum the Premier set in motion when he set up the department in 1986 to stimulate the growth of advanced technology in Alberta?

A: We are fortunate we have had five years to build a foundation and establish a solid infrastructure of support for Alberta business and industry.

We've built on the leadership and tradition of excellence provided by the Alberta Research Council for almost 70 years. We've added to that base of excellence the Electronics Test Centre and the Biotechnology Toll Fermentation Facility at the ARC.

The Alberta Research Council is working closely with our universities and together they are moving both basic and applied research towards commercialization.

The ARC has a toll-free "technology line" (1-800-661-2000; in Edmonton, 450-5000) to link business with some of the best research facilities and technical expertise in the province.

We maintain the momentum by maintaining confidence in the spirit of Albertans and their ability to compete and win. Winners like INTERA, Northern Telecom, Synphar, and Sherritt will continue to excel if we provide them with a solid economic environment based on responsible fiscal management. That is what we are doing.

Q: Advanced technology companies are finding it tougher every day to attract the highly trained people they need. What are you doing to help them?

A: It is people who will make the critical difference in our ability to compete in a knowledge-based economy.

In the future, intellectual property will become the currency of prosperous nations. You bet people are the most important natural resource given to us.

We need to work together with Alberta Education, Alberta Advanced Education and Alberta Career Development and Employment to meet the needs of industry in the '90s.

For example, Career Development and Employment and my department have recently published a brochure titled Leading Force: Advanced Technology and the Alberta Labour Market. The brochure provides information about Alberta's labour force, government research institutes, universities and lifestyle that will be of interest to employers who are involved with advanced technologies.

We have sponsored Alberta's first ever Science and Technology Week. We have supported the development of Alberta's Science and Technology Leadership Awards.

We have launched a student awareness program to enhance the appreciation of advanced technology among young people. If we capture the imaginations of young people, by the year 2000 industry should start to see results. They should by then, be able to find the qualified and skilled people they need to compete globally

Q: With an increased emphasis on a market-driven economy, can we really afford the luxury of basic research?

A: Basic research is the foundation of advanced technology, and fostering basic research will provide us with the intellectual currency we need to compete in the economy of the future.

However, in the context of limited financial resources, we must be more creative in the ways we develop our knowledge base.

Q: Does that mean marketing needs to play a larger roll in the development cycle of new products and processes?

A. When dealing with brand new products it is not always possible to predict what the market will accept.

We are now doing more work up front on defining and identifying customer needs and then developing and commercializing the products and processes to meet those needs.

The WESTAIM partnership venture with Sherritt Gordon, the federal government and the province, besides being a model of collaboration, is a good example of developing applied research which will be market-driven.

Q: Will advanced technology manufacturing pose a threat to the environment?

A. On the contrary, I believe technology will enhance the concept of sustainable development and help solve environmental problems.

Biological pesticides are being developed at the Alberta Research Council which will help replace chemical pesticides. Alternatives are being found to chlorine for use in the pulp industry. Re-usable plastics and recycling programs are being developed based on technology processes and products. Technology holds out a lot of hope for solving our environmental problems.

Q: What is your vision for the future?

A: Advanced technology will be the fastest growing area in our move to broaden Alberta's economic base. The role of the department is to provide leadership in bringing our resources, technology and people together with business and industry in a reasonable and coordinated effort.◆

The Hon. Fred A. Stewart Charts the Course for Advanced Technology in Alberta

Alberta High T

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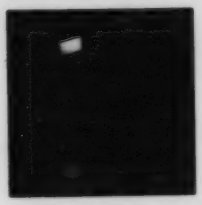

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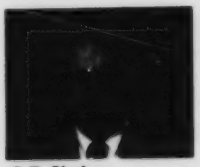

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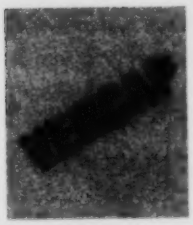

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Western Research is a leading environmental engineering and technical services company and a major manufacturer of environmental and process instrumentation products. Western Research is based in Calgary with a branch office located in Denver, Colorado, and provides these products and services worldwide through direct marketing and product representatives. Western Research, 1313 - 44th Avenue N.E., Calgary, Alberta T2E 6L5, Phone (403) 291-1313, Telex 03-827569, Fax (403)291-1128

A GUIDE TO THE WORLD OF SCIENCE

WELCOME TO SCIENCE CITY, ALBERTA. POPULATION 200,000.

It's a fascinating place to explore. Because it's home to all the people, facilities and support services involved directly or indirectly in Alberta's advanced technology industry.

And you're invited to share in its spirit of innovation, its international record of achievement and its dynamic vision of the future.

OF CORNERSTONES AND BUILDING BLOCKS.

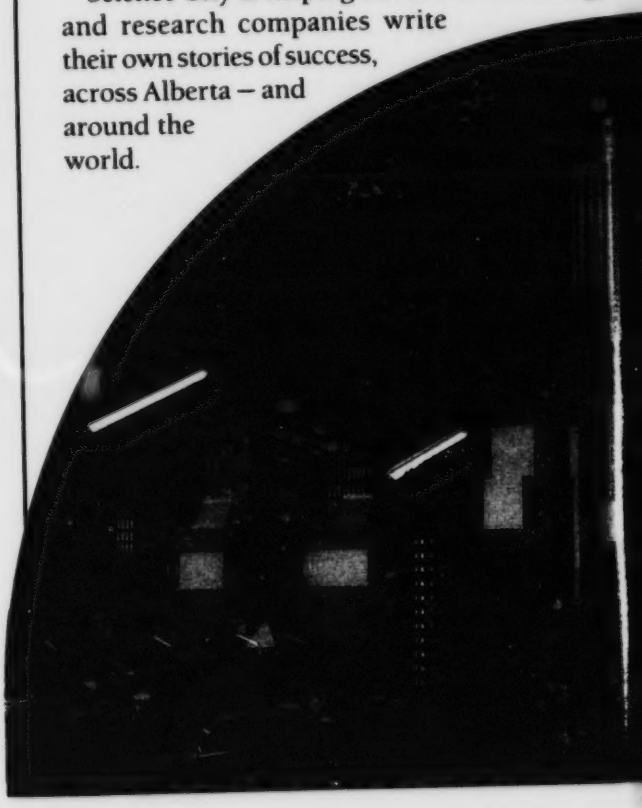
You won't find Science City in any atlas. But you can see the progress it is making towards a better way of life throughout Alberta.

Since the early 1900s, its efforts have been built on foundations provided by the provincial government, like the Alberta Research Council. In recent years we've built further on this tradition by adding the Alberta Oil Sands Technology and Research Authority, the Alberta Heritage Foundation for Medical Research and the Alberta Telecommunications Research Centre.

Such facilities give industry and educators the room they need to grow; to push the limits of existing technology; to develop new levels of skills, products and services; and to make their mark internationally.

MILESTONES OF OUR SUCCESS.

Science City is helping advanced technology and research companies write their own stories of success, across Alberta – and around the world.



FOR MORE INFORMATION ABOUT ADVANCED TECHNOLOGIES IN ALBERTA, PLEASE CALL OR WRITE; SCIENCE CITY, THE GOVERNMENT OF ALBER

FAMOUS LANDMARKS CITY, ALBERTA.

A biotechnical company is leading the way in advanced embryo transplant techniques to improve cattle breeding. Including entering into the first agricultural joint venture between Canada and the Soviet Union.

Another company is at the forefront of North American research, development and manufacture of cellular telecommunications systems and telephones. It's currently making history in one of China's larger cities by supplying the first cellular telecommunications system to be used in place of a wired system.

Then there's the Alberta firm that's Canada's only entry in the race to build the world's fastest supercomputer. And a thousand other companies are involved in projects as diverse as finding cures for cancer to mapping a huge motorway in Turkey.

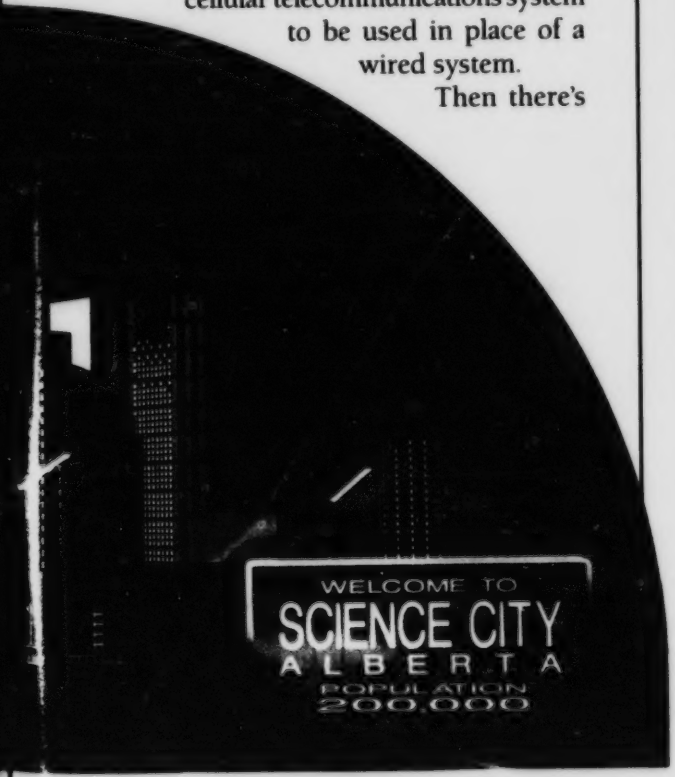
They're all corporate citizens of Alberta's Science City. And their accomplishments are putting Alberta on the map.

A BLUEPRINT FOR A BETTER TOMORROW.

Science City has set its sights on even more landmark achievements in the 1990s.

By working with the Alberta government to create world-competitive research facilities, better support systems and more transfer of technology, Science City will help to build a stronger, more diversified economy. And open the door on more employment and career development opportunities for Albertans.

There are no limits to what Science City can accomplish. Because there are no limits to the vision on which it is built. You won't find Science City in your Atlas, but it is putting Alberta on the map.



Alberta

TECHNOLOGY, RESEARCH and TELECOMMUNICATIONS

TECHNOLOGY, RESEARCH & TELECOMMUNICATIONS, 10909 JASPER AVENUE, EDMONTON, ALBERTA T5J 3M8 TELEPHONE: (403) 422-0567

Keyword Office Technologies Ltd

"With Quality and Simplicity, Improving the Productivity of People by Enhancing Compatibility Among Automated Office systems"

Key words management team: (l to r) Steve Corbett, Don Boone, Bob Blackshaw, Jay Jaiswal

In the overall computer systems markets, Keyword OfficeTechnologies Ltd. has, since 1980, been a distinguished force in pioneering the development of high quality hardware and software for "document interchange".

Keyword Office Technologies Ltd. is a 100% Canadian owned and controlled corporation. The company has grown from a two person operation to employ over 85 dedicated employees.

Keyword functions in full recognition of the need for a strategic and more productive information exchange system; both internally and externally, regardless of the type of document processing system used by an organization, without additional concerns about technological incompatibility.

The visionary corporate influence that directs the solid core of professional team members is Mr. Robert Blackshaw, president and chief executive officer of Keyword. Mr.Blackshaw is the co-founder of Keyword and, with Mr. Corbett (executive vice-president), Mr. Jaiswal (vice-president and general manager, sales and marketing), and Mr. Boone (vice-president and general manager, operations), provides dynamic guidance to the skilled employees that share the aspirations and chart the course of progress with thorough research and innovative development.

Keyword maintains a unique market position as the only company offering a full range of "document interchange"products. The market applications are varied, flexible and geared to customers' specific requirements, allowing the client more productive use of existing hardware and software.

Keyword Keypak® products are a prime example, capable of integration with common computer system user interfaces.These applications specifically include the integration of systems and terminals into a document distribution and exchange network; the creation of a compatible document interchange environment among systems and terminals that will continue to use incompatible document formats, and an extension of computer system based E-mail to handle revisable documents.

Extension in E-Mail information exchange stands to be a significant market, as offices advance towards new information systems based on E-Mail as the under pinnings of the next major wave of development.

In conjunction with document translator systems, like the 8000™ Gateway, Servicepack™, and Softpak™, Keypak® will in future provide the bi-directional interchange of various non-textual objects, through products like the Keypak® Spreadsheet Interchange, the Keypak® Graphics interchange and the Keypak® Image Interchange.

The basis of these products is KODA—Keyword Open Document Architecture. KODA's canonical form—Keyword Standard Interchange Format (KSIF)—is a superset of various proprietary interchange formats, including extensions for older, dedicated word processing systems, and extensions permitting the implementation of compound document translations including text, line drawings, spreadsheets, graphics, and image and voice annotation objects.

Keyword "document interchange", Keypak® is applied in the market to Integrated Office Systems (proprietary or vendor-specific) such as Digital Equipment's ALL-IN-1 or Data General's CEO offering; Integrated Office Systems (UNIX) such as Uniplex's Uniplex II Plus, and Quadraton's Q-OFFICE and Local Area Networks (LANS). These are indicative of software products connecting PC's, MACs, terminals and work stations for common file storage, and access and information exchange between disparate end users.

The strategic planning, comprehensive organization, and labour intensive efforts of Keyword have resulted in global recognition. Through representatives in Boston, Calgary, Chicago, Dallas, Ottawa, and Washington, Keyword has established a solid distribution network in North America. A combination of computer systems dealers, distributors, and value-added resellers market Keyword products to the rest of the world. On a product-by-product basis, global remarketing agreements are used for distribution through OEM's.

Proprietary technical information from vendors is essential to develop products suitable for interchange. The recognition and support of

the top systems vendors in the world affords Keyword the cooperation of this community in Keyword's research and development.

The ongoing development of quality relationships in the information systems community is of the upmost importance to Keyword. The benefits are twofold: a solid distribution network, and heightened awareness in the market inconjunction with a valuable information resource to future growth and advancement.

Keyword has access to a remarkable cross section of the"global information system" community on many computer platforms and operation systems, thanks to contracts with vendors that allow the company to provide "document exchange" capabilities within specific product lines in over 40 separate document projects.

Attentive to change, and cognizant of the rewards of cooperation, Keyword strives to maintain the leadership role it has achieved. As international organizations endeavour to devise standards for document exchange, Keyword will enhance its technology with consistent research towards the eventual incorporation of all document processing object types in conformance with the International Standards body.

In 1989, Keyword created a substantial bond with the Digital Equipment Corporation (DEC) and AT&T. DEC the leader in the Integrated Office Systems market, and Keyword entered a cooperative marketing program, giving Keyword access to 3.3 million users in DEC's installed base. AT&T announced that Keyword was the internal vendor of choice for document Interchange on all AT&T UNIX systems within its corporate family. UNIX will likely experience marked growth due to general moves to more open systems. UNIX is of considerable significance in the United States and Europe.

Keyword has also negotiated numerous site and corporate license agreements for its Keypak® product line. These clients include AT&T, Bell South, DuPont, External Affairs Canada, Los Alamos, Martin Marietta, NIEHS, Orange County, Rockwell International, Sandia, US West, and the World Bank.

Keyword views the relationships that it has created within its customer base, its major vendor OEM remarketing arrangements, and its cooperative marketing partnerships, as vital to its market strategy and leadership.

Along with "global information systems" community relations, another of Keyword's prime thrusts is its Research and Development Program. An average of 10% of annual revenue is committed to research and development. Keyword is the only company in the world to uphold such a significant and focused commitment to document exchange technology.

Calgary headquarters is Keyword's centre for the enhancement of existing proprietary software and hardware.This program's goals are to enhance Keyword's technical portfolio and provide the company with a greater line of products. The dedicated efforts of Keyword's skilled teachers have built a worldwide reputation for excellence in product development and support. Keyword's strategy is to be "the Switzerland" of the information systems community. Its people and knowledge base centered in Calgary are unique. Keyword translators and converters use KODA as the core; likewise, builders of Information Systems are using Keyword as their hub.❖

Keyword Team

KEYWORD

Edmonton Research Park

Western Canada's Technology Development Centre

The Edmonton Research Park has become Canada's preferred site for advanced technology industrial activity since it opened its doors in the early '80s. Beginning with a single company employing 30 people in 1983, the 320-acre research and technology community has expanded exponentially—to the point where 35 companies and organizations will be operating from the park by the end of 1990. This growth record is unparalleled in Canada, and places the Edmonton Research Park among the top 20 in the world in terms of serviced land, number of companies, and population, according to the Association of University Related Research Parks.

The Edmonton Research Park is a deliberately planned land and building community, designed to provide an outstanding environment for the pursuit of advanced technology research, product design and development, pilot and prototype development, engineering, light manufacturing and office support functions. Today's scientists, engineers and technicians require an optimal environment to carry out their knowledge-intensive work—an environment which blends the best elements of first-class industrial sites and buildings with the university and college campuses where these "knowledge workers" developed their skills and expertise. The Edmonton Research Park is such a location: a perfect blend of a place to think and a place to achieve.

What are the factors that have attracted so much development activity and growth at the Edmonton Research Park?

The park is restricted to organizationsi nvolved in some facet of advanced technology activity, with the exception of a designated area set aside for activity considered complementary to the primary technology community. This close-knit community promotes personal and professional exchange opportunities between companies, and has increasingly to inter-company business opportunities as well.

Development standards and design guidelines ensure only high-quality development occurs within the park. Setback requirements, extensive landscaping, and designated recreation areas all contribute to the "quality of life" in the park and protect the investment of companies in their sites and buildings.Strategic location—The park is ideally located for technology-intensive business which demands rapid access to air services, business services and university research. The park is readily accessible by car to the Edmonton International Airport (12 minutes), the downtown business district (20 minutes), the University of Alberta campus (12 to 15 minutes), hotel and convention facilities (5 minutes),and excellent residential areas in all price ranges.

The park provides fully serviced sites for sale or lease, customized multi-tenant building for medium- or long-term lease, and a technology incubator (the Advanced Technology Centre) to house and provide business support for entrepreneurs and early-stage companies.

The University of Alberta takes an active role in park development through its appointments to the park board, and the park support and assists in the transfer of technology from the University to industry. Among the six largest companies in the park, four can trace their origins directly to the University of Alberta, and the other two have significant technology transfer agreements with the University.

The Alberta Research Council is Canada's largest and oldest provincial research organization, and is an anchor tenant of the park. The ARC delivers a number of significant programs of support to advanced technology industry from its location in the park, including the NRC-sponsored Industrial Research Assistance Program, joint-venture research programs, the Electronic Test Centre, and the Biotechnology Pilot Plant. In addition, the ARC libraries, theatre, meeting rooms and cafeteria are available to park companies.

In addition to nearby commercial and business services in south Edmonton, the park also provides a variety of business services from its offices at the Advanced Technology Centre.

Park companies benefit both directly and indirectly from the park's national and international reputation as a hotbed of technology activity, and from the extensive promotion of the park and its companies by local, regional and provincial economic development agencies.

New companies continue to be attracted to the park by the availability of high quality serviced sites, the high standard of services, development standards and landscaping, competitive land prices and a flexible development process.

The Edmonton Research Park's research and technology community is both diversified and leading-edge in a number of advanced technology fields.◆

Edmonton Research Park: *Canada's growth centre for research and technology business*

Glenn A. Mitchell, President
Edmonton Research Park
203 Advanced Technology Centre
9650 - 20 Avenue
Edmonton, Alberta, T6N 1G1
Phone (403) 462-2121,
Fax (403) 428-5376

EDMONTON RESEARCH PARK

Advanced Technology Centre

The Advanced Technology Centre, a project of the Edmonton Research Park, is a "business incubator" for technology-intensive companies. Completed in mid-1988, the Advanced Technology Centre is designed to provide a nurturing environment for early-stage and start-up technology-based companies, and a training ground for a new generation of technological entrepreneurs who will be the cornerstone ofAlberta's technological future.

Qualified high technology companies must make formal application before admittance to the Advanced Technology Centre. Once admitted, companies benefit from a very supportive environment, which includes such amenities as affordable and flexible space, shared office and secretarial services, and management and financial assistance. This combination of facilities and programs is directed at the special needs of small technically oriented business (see diagram below). Eventually, companies will "graduate" from the centre and continue their growth as independent companies. It is expected that the average company will remain three to four years in the centre.

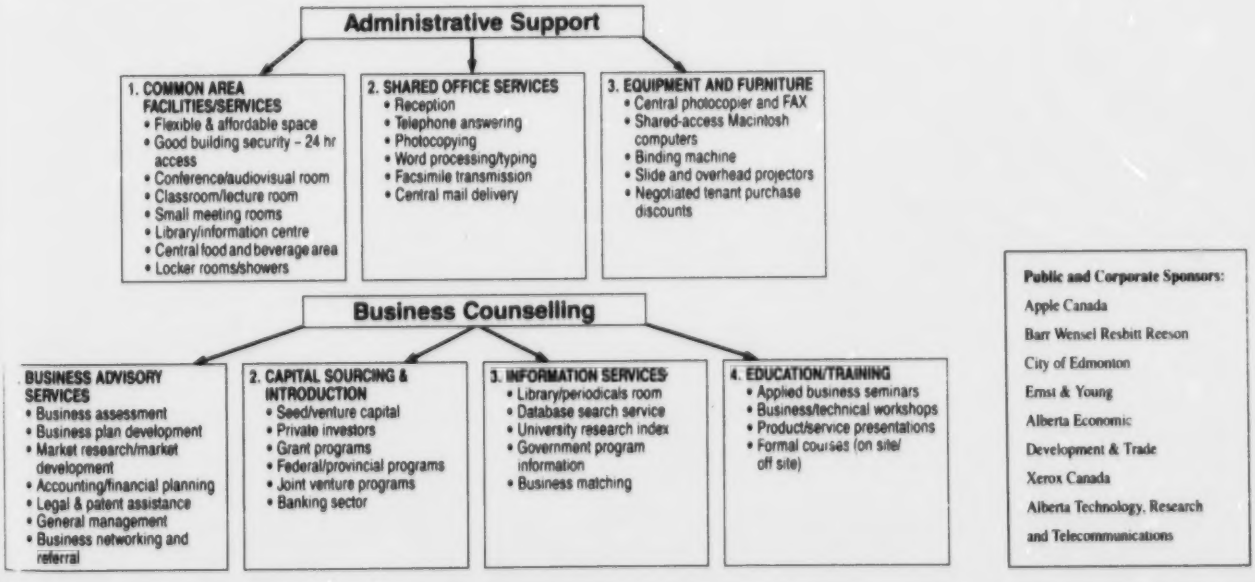
The Advanced Technology Centre has been able to attract a great many public and corporate sponsors who recognize the quality of the programs and the importance of improving the survival rate and growth of early-stage technology-based enterprise. Interest from high technology companies has also been strong. Over 20 companies have decided to relocate to the centre during the first two years of operation.

Though the centre has won many accolades and awards for its economical blending of function and esthetics, the real success story is more important than the building's striking design features. The ultimate success of the Advanced Technology Centre will be gauged by the number of tenant companies who grow and prosper in the centre. One of the more important benefits for participating companies is that they can exchange ideas and strategies and learn from one another.This synergistic and helpful atmosphere happens when companies at a similar stage of corporate development with mutual business interests are brought together. One common hurdle for high technology companies is finding the necessary capital to fund product development and corporate growth. Companies at the centre have been successful in raising over $3 million in public and private capital during their residencies at the centre.◆

Richard Hermes, Manager
Phone (403)-462-2121, Fax (403) 428-5376

Advanced Technology Centre: *An incubator for technology entrepeneurs and companies*

Advanced Technology Centre



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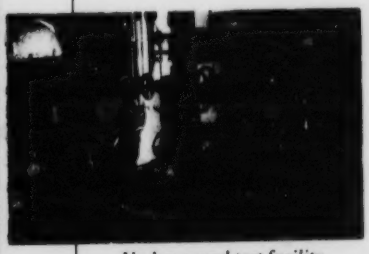
AOSTRA

A world leader in oil sands research



Underground test facility

Contact Jackie Alton
AOSTRA
500 Highfield Place,
10060 - 106 Street
Edmonton, Alberta,
T5J 3L8
Phone (403) 427-7623
Fax (403) 422-9112

The Alberta Oil Sands Technology and Research Authority was established in 1974 as a crown corporation of the province of Alberta. Its original mandate was to develop, in collaboration with industry and universities, economic and environmentally acceptable technology for the recovery and processing of petroleum from the Alberta oil sands; this has been expanded to include heavy oil and enhanced recovery of conventional petroleum.

In round terms, only 10% of Alberta's oil sands can be recovered by surface mining. Recovering the remainder requires the development and application of new technologies. In achieving its objectives, AOSTRA has worked with 64 industrial organizations, from large multi-national petroleum companies, to small entrepreneur-driven groups.

AOSTRA is a crown agency administered from offices in Edmonton by a board of experts selected from the private sector, by order-in-council of the provincial government. The chairman and CEO, W.J. Yurko, and vice-chairman R. Luhning, are also appointed by the provincial government. Technical experts employed by AOSTRA work out of offices in Edmonton, Calgary and Fort McMurray.

One of the major fruits of AOSTRA's activities is the bank of technology, developed in Canada and owned by AOSTRA, that is available for sale or trade to oil companies or other countries in return for other technologies. At the end of 1989, AOSTRA held 48 patents world-wide in countries including Canada, the United States, Romania, Turkey, Venezuela and the European Economic Community. A further 19 patents have been applied for.

Two of AOSTRA's joint projects with industry are now fully commercial operations, and several others are approaching that stage, including an innovative mine-access approach to production.

AOSTRA's co-operative efforts extend far beyond its industrial endeavours. It has sponsored programs with research groups in 17 Canadian universities and ten research organizations. In order to benefit from shared information worldwide, AOSTRA has developed working agreements with 17 oil producing countries. The Authority also assists small inventors through its Inventors Grant Assistance Program.

The Authority is aware of the need for trained personnel for the development of the oil sands, and has promoted a number of university programs which include professorships, scholarships and fellowships, an oil sands short course (for those presently employed in the industry), a university summer student employment program, and an international exchange of engineers and scientists.❖

Alberta
OIL SANDS TECHNOLOGY AND RESEARCH AUTHORITY

canuck
GIE ENGINEERING LTD.

Canuck GIE Engineering is an Alberta-based consulting engineering company providing professional services to both the domestic and international markets.

We offer unique solutions and systems to the petroleum and non-petroleum sectors in developing capital projects relating to the production, treating, storage and transmission of fluids or materials.

Rely on Canuck's expertise in:

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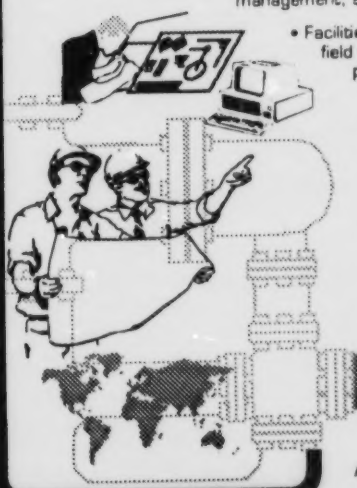


AN AGRA CONSULTING ENGINEERING COMPANY

200, 708 - 11th Avenue S.W.
Calgary, Alberta T2R 0E4
Canada

Telephone: (403) 267- 6000
Fax: 267-6099
Telex: 03-826678

Affiliated with Gulf Interstate Engineering

Microsim

"Productivity through Innovation"

Microsim Software Inc. is a private Alberta company, providing specialized software products to the oil and gas industry. "Our software is applicable to all stages of industry use from post-exploration to the pre-refinery stage," explains Tunde Agbi, president of the Calgary-based company and developer of the software products.

The software spans the full spectrum of technology in geological, production and reservoir engineering, as well as production accounting. An increase in productivity of up to ten times current levels, as well as cost savings of up to 40% can be realized by the software users, says Mr. Agbi. Engineering and geological studies can be completed in one-quarter to one-tenth the time.

Technically powerful, Microsim products are designed by engineers and geologists for use by engineers and geologists. The software emphasizes practical solutions based on technical experience.

Each Microsim software product is fully integrated; the user is able to integrate the result of one analysis with the next logical software product. However, each of Microsim's individual software products is capable of standing alone. Mr. Agbi points out, however, that: "The results of a single application rarely constitute a total solution to a given petroleum asset management problem."

This integration is particularly suited for Petroleum Asset Management Systems (PAMS), which need more than one piece of software to make a decision. It is more efficient to have the data stored in a central location, instead of entering it for each application.

The demand for integrated software products is high: efficiency, ease of use, and technical accuracy all help companies save time and money.

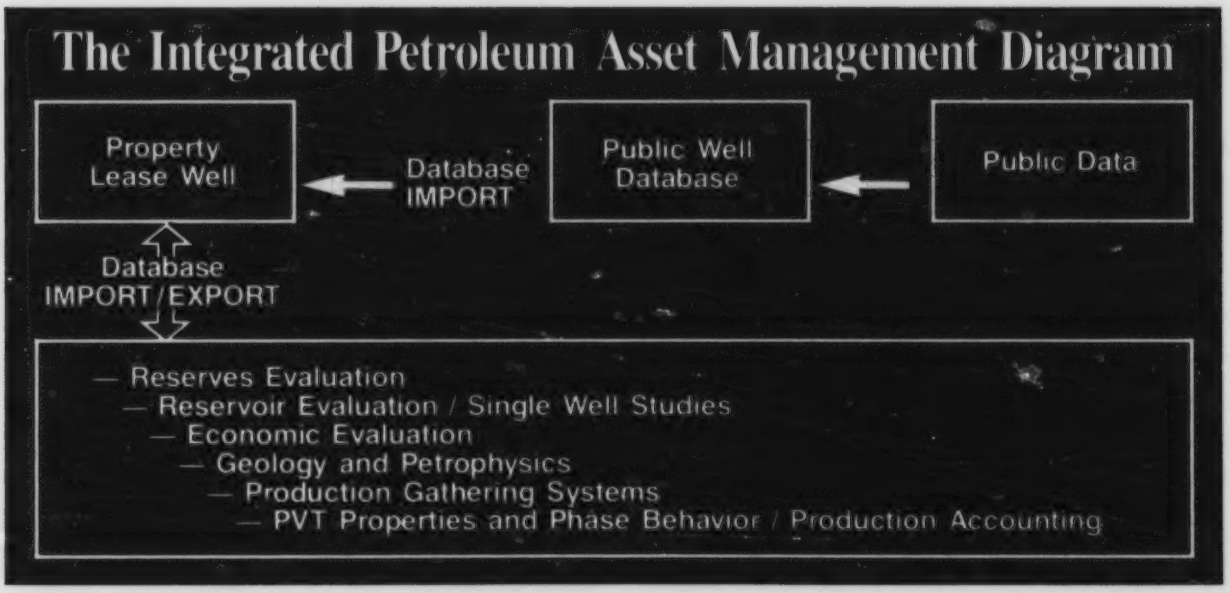
There are a number of major and minor companies using Microsim's software: Amoco Canada, B.C.'s Ministry of Petroleum and Natural Resources, Canadian Hunter Exploration, Canadian Northstar Energy, and more.

Microsim products will run on all major hardware operating systems such as UNIX, Xenix, DOS and VMS. Because Microsim's software has been for the most part designed as an open system, Microsim will be able to extend the application of several of the existing technologies to other natural resource areas. The mapping software has potential for applications in other natural resource areas including forestry and mining.

Microsim has invested several million dollars over the past four years in product development, and will continue to develop additional capabilities through its research and development program.

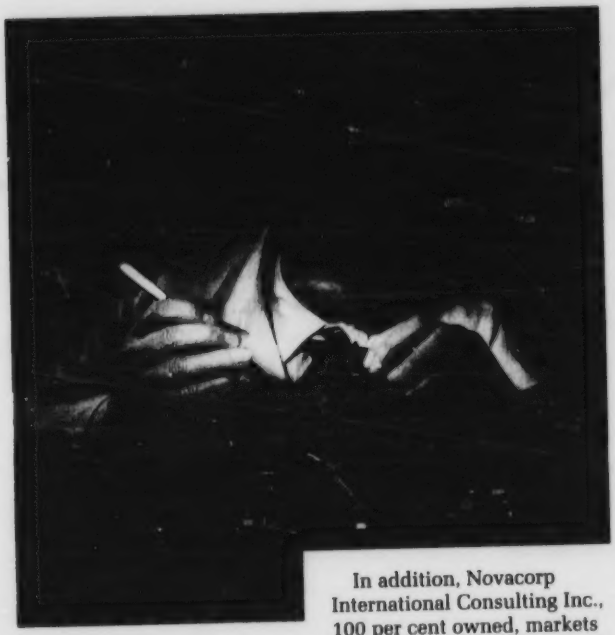
The company has largely confined its sales and promotion efforts until now to North America, but Microsim is now ready to move into the global market. It is confident it will gain the same high acceptance overseas as it has received at home. ❖

Microsim Software Inc.,
P.O. Box 6954, Station D.,
Calgary, Alberta T2P 2G2
Phone (403) 297-9100, Fax (403) 233-2542


The Integrated Petroleum Asset Management Diagram
Property Lease Well
Database IMPORT
Public Well Database
Public Data
Database IMPORT/EXPORT
— Reserves Evaluation
— Reservoir Evaluation / Single Well Studies
— Economic Evaluation
— Geology and Petrophysics
— Production Gathering Systems
— PVT Properties and Phase Behavior / Production Accounting

Development and Applic

Keeps NOVA Competitive in Alb



NOVA Corporation of Alberta, one of the largest and most productive petrochemicals, plastics and natural gas pipeline companies in North America, is committed to the development and application of new technology that creates value-added products and services, and effective new methods of doing business.

The Corporation's research group employs about 400 scientists, engineers and technical support staff. In 1989, NOVA spent approximately $48 million on research and development activities and an additional $17 million on product support research activities related to improvements of existing products, services and processes.

These activities, conducted at major facilities in Canada and the United States, are an essential component of NOVA's ability to achieve and maintain its position as a preferred supplier of goods and services.

NOVA operates internationally from world headquarters in Calgary, Alberta. NOVA builds its businesses principally on the pipeline transportation of natural gas and the manufacturing and marketing of materials processed from hydrocarbons.

In 1989, the Corporation generated almost $5 billion in sales and more than $185 million in net income on assets of about $8 billion.

"NOVA's technological activities produce state-of-the-art technology and our key objective is to remain efficient, productive and innovative. This long-term commitment reduces risks, improves profits and stimulates growth," said George Miller, vice president of research and technology development.

"If you want to last in business, you need a strong commitment to research and development of new technology. Basically, it's a key investment in your own future."

– George Miller
NOVA Vice President of Research and Technology Development

In addition, Novacorp International Consulting Inc., 100 per cent owned, markets the application of specialized products and provides technologically advanced engineering and operating consulting expertise in pipeline transportation systems and petrochemicals to clients around the world.

Technology ventures are based on three main factors.

"We aim to improve continually in those areas in which we already do business. We aim to develop new markets based on those existing businesses. And we hope to create entirely new lines of commercial activity based on our technological success. We have been very successful in the past and our emphasis on technological excellence will continue in the future," Mr. Miller said.

Moreover, NOVA supports codes of practice established by groups such as the Canadian Chemical Producers Association, the Canadian Petroleum Association and the Chemical Manufacturers Association in the United States, which include a code of practice for research and development.

"That means we have pledged to ensure, to the best of our ability, that any product or process we develop in the name of good business practice is not harmful to people or the environment," Mr. Miller said.

Petrochemicals

NOVA's Petrochemicals Division produces more than five billion pounds per year of primary petrochemicals such as ethylene, styrene and propylene at plants near Joffre, Alberta and Sarnia, Ontario. Methanol is produced at three plants in Alberta. The division also has interests in ethane extraction and gathering systems, product pipelines and storage facilities.

Technological investments are dedicated to improving production and reducing costs through better use of existing technology and the development of new methods of upgrading hydrocarbons such as natural gas and crude oil to produce primary petrochemicals.

Advanced process technology is in place to produce the most appropriate product slate from the most economical supply of raw materials.

In addition, existing plants have been "debottlenecked" through technology to allow increased production capacity at relatively low cost and to further reduce unit production costs. Since NOVA's ethylene plants at Joffre were opened, ethylene capacity has increased by more than 500 million pounds from the original design capacity without major capital investment. At Sarnia, the debottlenecking program in

ation of New Technology
erta and Around the World

1989 resulted in a 20 per cent increase in ethylene capacity.

Also under study are methods to upgrade methane to more valuable commercial products. At present, Alberta's abundant methane supply is processed into methanol. However, NOVA's long-term methane research has the potential to make the process more economical and to yield new methane derivatives.

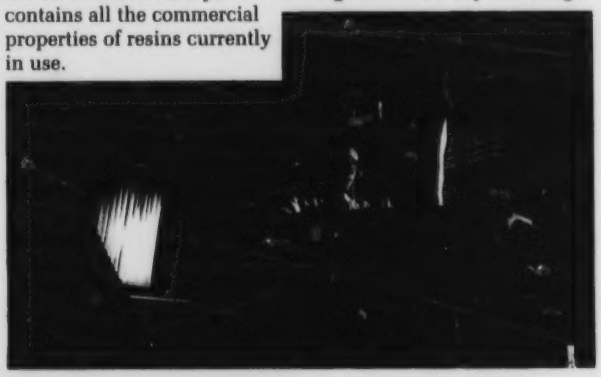
Plastics

NOVA's Plastics Division produces a broad range of plastics resins – polyethylene, polystyrene and polypropylene – at plants in Canada and the United States. Total production in 1989 was almost two billion pounds. The division is also focusing on the growth of a range of higher performance plastics resins. In addition, NOVA's technical centre provides product analysis, research and development to ensure customers receive the most appropriate product for specific applications.

Technological programs reduce costs, increase plant capacity and allow use of more economical manufacturing technology. At NOVA's Joffre polyethylene plant, capacity has increased from an initial 600 million pounds per year to the point where it is possible to sustain production at a rate of about one billion pounds.

Also at Joffre, technological improvements are under way to introduce a new range of hexene-based polyethylene resins and to pelletize more of the plant's total production. These procedures will increase production and provide customers with a more extensive product line.

Technology is also focused on the production of performance-oriented products such as resins for clear plastic applications; polyethylene geomembrane sheet for use as liners for landfill sites and ponds; and thermoplastic olefins that are used increasingly by the automotive industry. These value-added products command premium prices because of their unique properties. In addition, work is under way on development of several environmental polymers, including an entirely new type of plastic that is completely friendly to the environment and yet contains all the commercial properties of resins currently in use.



Pipelines

NOVA owns and operates a 9,700-mile natural gas gathering and transmission system in Alberta. Annually, the NOVA system transports about 80 per cent of marketed Canadian gas production. It is widely recognized as one of the most technologically advanced pipeline systems in the world.

There are several examples of new technology that have been developed to further improve efficiency and safety of NOVA's pipeline business. These include projects to augment measurement and control of natural gas, and an automated dew point monitor to determine condensation points in pipeline systems.

In addition, long-term work is conducted on gas dynamics, including studies of pressure pulsations and ways to control them. A full-size test loop facility was built in Alberta to aid research by approximating real operating conditions. To date, NOVA has produced a comprehensive computer program that can model the flow acoustics of any piping system and allow a pipeline engineer to modify the design to minimize the pulsation level.

Since the late 1970s, NOVA and Novacorp have been extensively involved in the development and application of mechanical dry gas seals. Together with magnetic bearings, also supported and promoted by Novacorp, this technology increases safety and reduces maintenance costs by allowing compressors to operate without oil lubrication systems.

The technology is used extensively in NOVA's pipeline system and marketed to other companies around the world. It is also transferable to other industries, including NOVA's petrochemicals and plastics operations, and to date, Novacorp has installed dry seal units in two compressors at NOVA facilities in Sarnia.

To find out more about NOVA's technological activities or any of Novacorp's products and services, please contact:

NOVA Corporation of Alberta
Corporate Communications
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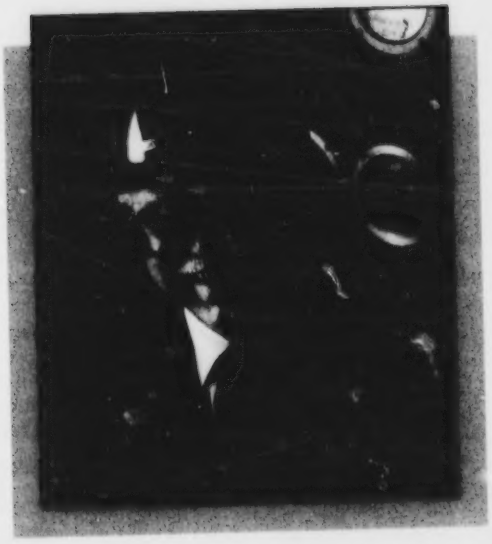
NOVA

BUILDING THE FUTURE WITH ENERGY

BRINGING THE OIL SANDS TO LIFE



JOHN CLARK

RESEARCH MANAGER
SYNCRUDE CANADA LTD.

Syncrude Canada Ltd.'s goal is to secure our nation's energy future through the development of Alberta's Athabasca oil sands.

Already, Syncrude is the world's largest producer of synthetic crude oil. Syncrude supplies 10 percent of Canada's oil requirements from its plant near Fort McMurray, Alberta. As one of Canada's most outstanding engineering achievements and Alberta's largest private sector employer, the plant integrates a mine, refinery, extraction plant and utilities plant. Production averages more than 160,000 barrels a day.

DOING IT BETTER

To fulfill its mandate, Syncrude relies on research and development and the pursuit of technological advances. This relentless commitment to "do it better" has launched scientists and engineers on one of the most aggressive and highly-focused research exercises ever undertaken in Western Canada. Present research is directed at studies on restraining environmental impacts, developing future reclamation plans, increasing efficiency and reducing production costs.

Technology, developed in-house, focuses on a variety of projects such as increasing the recovery and energy efficiency of the hot water extraction process to yield improvements in the combination of coking and hydroprocessing for upgrading bitumen. Another initiative is the application of expert systems to monitor and control the extraction process—a joint project with CANMET and a variety of universities which could lead to real gains in the future.

RESEARCH DEVELOPMENT

Syncrude's Research and Development team of approximately 165 employees is one of the largest and most focused industrial research and development groups in Western Canada.

In Syncrude's Edmonton Research Centre of 130 researchers, an annual budget of $12 million helps pursue a wide range of projects in lab and pilot plant settings. In Fort McMurray, 35 development engineers take promising technology from research and world-wide sources and apply it to projects, including improving the reliability of major mining equipment and innovative environmental studies.

As Syncrude fulfills its commitment to new and innovative technological advances, research and development continues to play a significant role in the operation's success. During the past 25 years, Syncrude has moved to the forefront of oil sands technology. Through continuing dedication, spurred on by research and development, Syncrude will bring the oil sands to life. And ensure Canada's energy future.

Syncrude Canada Ltd.

Husky Oil

The Right Mix of People and Technology

Husky Oil Ltd. is an internationally active Canadian petroleum company with headquarters in Calgary, Alberta. Husky is involved in the exploration, development, production, purchasing, transportation, refining and marketing of crude oil, natural gas, natural gas liquids, sulphur and refined petroleum products.

Husky ranks among Canada's top producers of crude oil, natural gas and sulphur. With assets of $3.7 billion, Husky is strategically placed in the North American energy market with proven reserves (as of December 31, 1989) of approximately 250 million barrels of crude oil and natural gas liquids; 1.6 trillion cubic feet of natural gas; and 9 million long tons of sulphur.

Husky Oil's Ram River plant—one of the most advanced sour gas processing plants in North America.

Husky is a petroleum company with a concentrated business mix that includes the key segments of the industry. Husky is positioned to become a leading petroleum company in Canada. Its quality petroleum assets provide for significant upside potential as a result of stronger petroleum prices in the 1990s.

Husky places a signficant emphasis on research and technology because it is critical to future opportunities for Husky. The Company devotes considerable resources to the development of its staff's technical expertise and new technologies.

Husky's major research asset is its people. Husky has a staff of experienced, highly qualified personnel with strong technological, scientific and engineering capabilities. Husky strives for the proper application of technology in everything that it does because improper usage costs money. Proper technology is cost efficient and cost effective. To ensure this each business segment is supported by scientific pools of talent that provide the necessary expertise to fully develop and optimize Husky's business opportunities.

Husky has a dedicated research capability through the NOVA/Husky Research Centre (NHRC). NHRC is devoted to basic and applied research in support of NOVA, Husky and other affiliated companies.

Husky's wholly owned subsidiary, HRI Inc., is a worldwide leader in hydrogenation technology. HRI specializes in the development and licensing of advanced technologies for producing environmentally clean fuels from various fossil fuels such as heavy crude oils and high-sulphur coals. As a leader in heavy oil and coal-liquefaction technologies, HRI promises to play an increasingly important role in helping the world meet its energy needs in an environmentally clean manner.

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Of Science And
Technology
Advisory Councils

Canada's Science Summit

Hilton Hotel
Edmonton
May 27-29, 1990

Hosted by
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Don R. Getty
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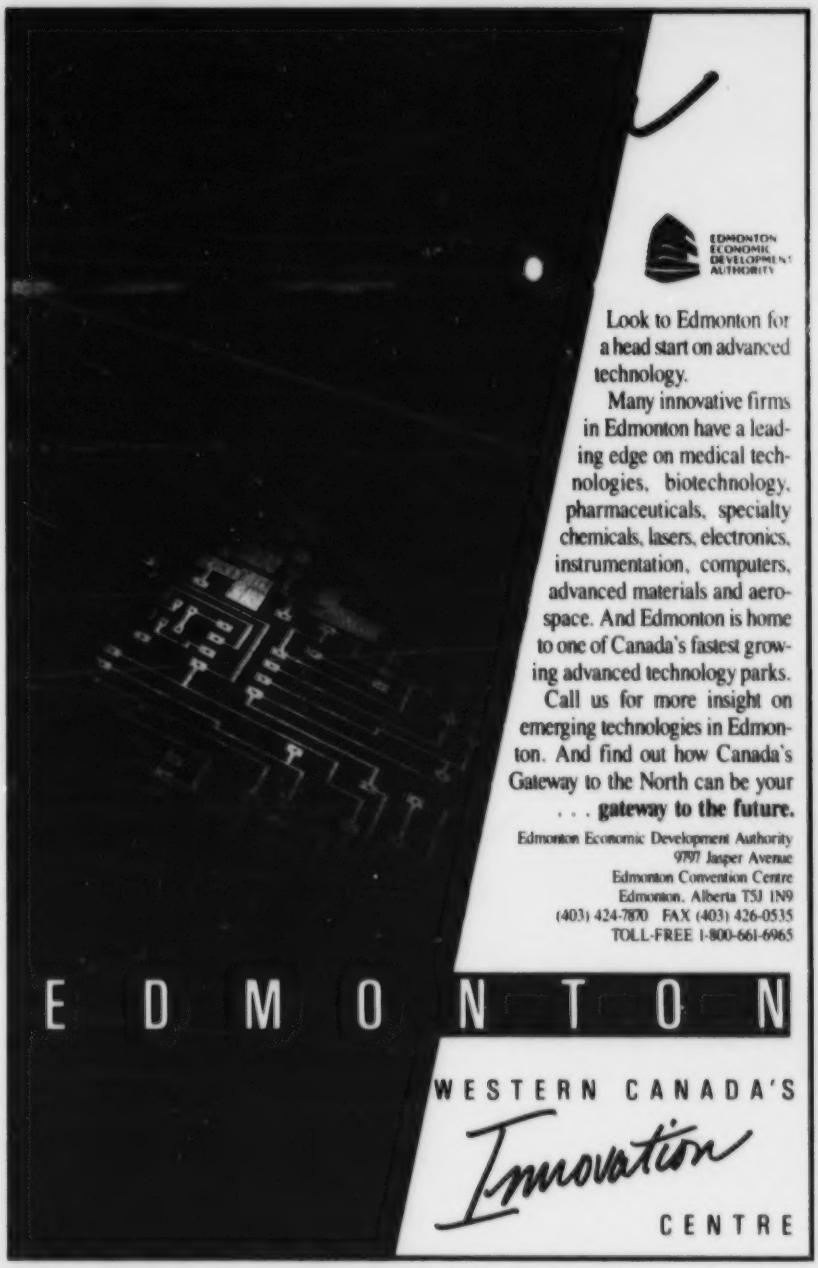
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Look to Edmonton for a head start on advanced technology.
Many innovative firms in Edmonton have a leading edge on medical technologies, biotechnology, pharmaceuticals, specialty chemicals, lasers, electronics, instrumentation, computers, advanced materials and aerospace. And Edmonton is home to one of Canada's fastest growing advanced technology parks.
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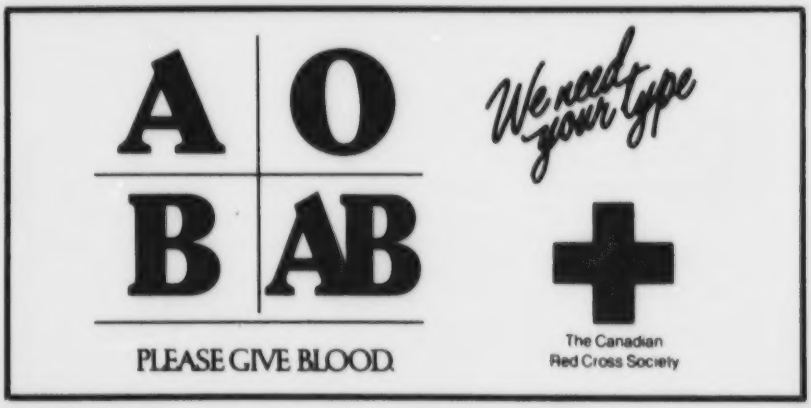


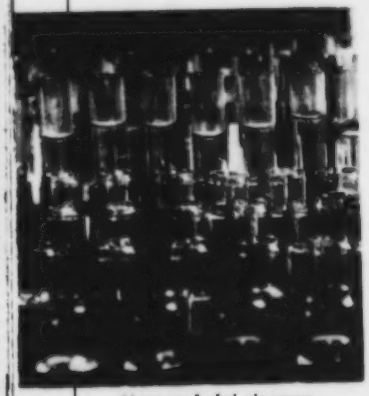
Norwest Laboratories

Canada's foremost agricultural and environment a laboratory

Delivering the highest quality analytical service to its clients has been the goal of Norwest Labs since the company's inception in 1975. Initially specializing in soil research and reclamation for the mining and petroleum industries, Norwest Labs has responded to customer needs and now provides quality analytical services in a wide variety of areas, including water quality analysis, industrial hygiene-asbestos testing, microbiology, hazardous waste assessment, and feed, seed and fertilizer analysis.

The company's dedication to excellence enabled Norwest to receive accreditation by the Standards Council of Canada in 1985; it was the first agricultural and environmental laboratory to obtain this status.

Norwest's main lab in Edmonton occupies over 18,000 square feet divided into progressively cleaner rooms for sample receiving, preparation, extractions and digestions, physical testing, wet chemical analyses, metals analyses, seed testing, microbiology, asbestos tests and computer services. Specialized equipment includes three Inductively Coupled Plasma Spectrophotometers with both simultaneous and sequential detectors for trace metals analysis. Laboratories are also located in Lethbridge, Alta., and Langley, B.C.



Norwest Labs' rigorous quality assurance program ensures the accuracy of analytical results

Norwest Labs participates in field trial research

Environmental soils analysis built the reputation of Norwest, and continues to be a major component of the laboratory's analysis. The company's expertise has expanded to include analyses, recommendations and research relating to oil and salt spills, sulphur and metal contaminated materials, pipeline disturbances, soil quality litigations, soil surveys and a variety of soil investigations.

In recent years, the increased use of diesel invert muds in oil well drilling has led to concern over the safe disposal of the cuttings that remain after drilling. This waste contains a vast array of hydrocarbons, and usually contains inorganic salts such as calcium and sodiumchlorides. Disposal by incineration or solidification is uneconomic and technically difficult. In an attempt to provide insight into the feasibility of land treatment of the residue, Norwest Labs has participated in a study co-sponsored by the Environmental Research Advisory Committee of the Canadian Petroleum Association and the Environmental Protection Service of Environment Canada. In brief, over a three year period, field tests proved that with treatment, revegetation can be achieved with minimal environmental impact.

Norwest Labs' scientists (under contract from the CPA) also drafted industry guidelines for the farming of drilling muds and continue to be involved in industry studies to determine the biological effects of drilling muds on plantgrowth. Growth room studies were conducted this spring, and field studies are scheduled for the summer of 1990.

Contaminated Real Estate Assessment

As concern over the environment continues to grow, requirements for the clean-up of contaminated land will become a concern prior to land purchases. Recent legal precedent in Canada and the United States puts the onus, at least in part, on the current owner of contaminated property to pay for clean-up.

Site investigations should be conducted by qualified personnel prior to any land purchase. Accurate analysis is imperative in assessing the clean-up costs, if any, on contaminated land. In this regard, Norwest Labs is often asked by clients to interpret analytical results and recommend further sampling procedures or land treatments.

Analysis of ground water is also an important aspect of the assessment of possible land contamination, and Norwest Labs' stringent quality assurance program ensures accurate results in this area as well.

Agricultural Soils, Feed and Water Analyses

Norwest's involvement on senior research projects and the participation of senior staff on Alberta Agriculture's Soil Fertility Committee have enabled the company to develop a credible system of recommendations based on quality soil analysis. From less than thirty samples in 1977, Norwest now processes more agricultural soil samples than any other laboratory.

As a leader in this industry, Norwest is currently co-ordinating the production of a video on soil sampling for fertilizer analysis. In addition, research staff continue to participate in various studies aimed at improving soil management techniques for the agricultural community.

In 1978, Norwest began offering feed testing to producers, feed dealers and feed mills. Twelve years later, the laboratory has expanded its range of services from routine protein and moisture to complete elemental, vitamin, and drug analysis.♦

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Micro Watt Control Devices Ltd

Industrial Control Systems and Service at their Best

Micro Watt Control Devices Ltd. has combined the distribution of process control equipment with innovation and leadership since 1984.

Marlene and Ken Coffey, the owners and managers of MicroWatt, attribute a great portion of the strength and growth of their company to "outstanding support services." A technically educated team offers expertise and experience to ensure that the best solutions to clients' needs are recommended during the sale of equipment. "We take a very close look at the application of a product, and will advise our clients of alternative choices of equipment that may be better suited to their needs," says Mr. Coffey.

Micro Watt makes certain that clients are offered advance replacement equipment while the units are in for repair, and "a substantive effort is made to repair faulty equipment in the shortest time possible," Mr. Coffey stresses, "especially with safety devices."

Micro Watt sales support includes the assembly of custom systems for specific client needs.

The proof of Micro Watt's success is its growth: from a two-person operation to an employer of approximately 20, with offices in Calgary and Edmonton, plus plans to open a new branch in Vancouver in the near future.

Micro Watt is the western Canadian distributor for Det-Tronics and Xycom, and has the exclusive distributorship for Transtector products in Alberta. "In addition, we have the Canadian distribution rights for new energy mangement technology from Energy Control Inc. of Calgary," Mr. Coffey states.

Detector Electronics Corporation of Minneapolis, Minnesota, known as Det-Tronics, was founded in 1973 to supply optical flame detection devices using ultraviolet (UV)light-sensitive technology. Mr. Coffey describes Det-Tronics as "an exceptional company, having the broadest line of optical flame technology available."

Today, Det-Tronics is the largest international company of its kind, with a full range of optical detection technologies including infrared (IR) and combination UV/IR detectors. UV and high-speed IR detectors are high performance flame detection systems with low millisecond response time.

Det-Tronics' industrial hazard protection equipment also includes combustible gas and hydrogen sulphide detection. "Det-Tronics gas detection equipment is noted for its high performance," says Mr. Coffey. "It is a premium product, backed by premium service at a premium, yet competitive price."

With offices in Canada, the U.S., Europe and Asia, Xycom is a world leader in the manufacture of dedicated colourgraphic terminals, industrial operator interface systems, work stations and industrially hardened computers.

The term "industrially hardened" means that these products have high tolerance for dust, humidity, noise vibration and concussion. They can be exposed to temperature and humidity extremes, shock, vibration and electrical noise: they can tolerate the "minefield" of the most difficult industrial environments.

"Transient surges on power lines result in harmful amounts of electrical voltage on A.C. power, signal or datalines," explains Mr. Coffey. "High energy transients can severely damage equipment."

For over 23 years, Transtector Systems of Hayden Lake,Ohio, has been a leading supplier of electrical power disturbance protection products and services. "Transtector protection systems are the best products in their class," Mr. Coffey states.

Transtector has developed an original technology which is the core of its equipment. The "Silicon Avalanche Diode", without degradation of the protector, instantaneously detects over-voltage and takes the energy to ground, bypassing the equipment.

Priced from under $100 to over $100,000, these sytems have a broad range of applications: from personal in-home electronics protection to massive industrial applications, offering supression capabilities from 8,000 to 2.5 million watts.

The most recent addition to Micro Watt's distribution lines is an innovative device researched and developed by Energy Control Inc. (ECI) of Calgary. The "Peak Advance Warning System (PAWS) was produced in response to Shell Canada's search for a device to lower industrial energy costs.

ECI offers knowledge and support to match PAWS to specific settings, and works with Micro Watt to assist industries in keeping electrical costs under control.

Micro Watt is receiving very positive feed-back on this new technology and, in keeping with the company's dedication to quality, will determine the distribution of technical control equipment that will compliment their product line and benefit from Micro Watt's excellent service and support system.◆

Marlene Coffey demonstrates a Xycom terminal to Ken Hodich(seated) and Dave Scheidt during a product training session

...Micro-Watt...
control devices ltd

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Fax (403) 291-6671

Raffin Electric Co. Ltd.

Providing special electrical requirement solutions

From the rugged mining and petrochemical industries to the fast pace of industrial production, there are many special electrical requirements looking for answers.

Raffin Electric Co. Ltd. has been designing and building solutions for over thirty years. Their controls, switchgear and retrofits have consistently provided the high quality of service and flexibility demanded by today's client.

Whether the need is for retrofitting an obsolete switchboard, or custom built panels and enclosures, Raffin Electric is there to create a cost effective solution. High voltage portable switchgear is customer manufactured to exacting standards of performance. Switch boards and other electrical components are designed for unique applications requiring special consideration.

Raffin Electric Co. Ltd. is Alberta owned and operated, with headquarters in Calgary. The staff of 60 have years of experience in developing and building equipment that consistently fills the need of the most demanding industries.◆

Raffin Electric Co. Ltd.
5539 - 1 St S.E. Calgary
Tel (403)252-7551

RAFFIN ELECTRIC CO LTD

Travco Industrial Housing Ltd.

Providing Accommodation for Remote Industrial Development

Life above the Arctic Circle can be tough, but Travco Industrial Housing Ltd. is making life more comfortable for workers enduring the hardships of the northern climate. Since 1979, Travco Industrial Housing of Nisku has been a custom manufacturer of modular industrial housing.

"We started in the oil and gas industry,," says sales manager Fred Newman, "but we have developed our market to include a wide range of industrial, commercial and residential uses for our buildings."

Travco's modular products can be configured in a variety of ways, including side by side, end to end, or stacked into multi-storey buildings. They can be custom designed to order for use as classrooms, offices, living quarters, and recreation areas, as well as kitchen and dining facilities.

"We offer the same features as regular frame construction," says Mr. Newman, "but we offer several advantages which stick-built housing can't provide." These, he says, include very limited on-site construction, with the option of being placed on a foundation or just left sitting on grade.

The buildings are constructed at Travco's huge production facility on a nine-acre lot in Nisku Industrial Park, just south of Edmonton. "Building the units inside allows us to manufacture in rain or shine," says Mr. Newman.

While a custom order may take up to two weeks to construct, once an assembly line is set up for standardized units, they roll off the line at the rate of one a day.

Travco has recently entered into two agreements in Alaska, providing mobile housing for maintenance crews for Alyeska Pipeline Service Co., and constructing a camp in Deadhorse on the shores of Prudhoe Bay for Halliburton Services. The company is also exploring possible opportunities with some Middle East companies as the need arises. Other projects for Travco's modular buildings include a golf course clubhouse, and a ski chalet, used as base for heli-skiing near Revelstoke, B.C.◆

For further information, contact
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Inventronics Ltd.

Inventronics manufactures a standard product line of electronic packaging, and also provides precision sheetmetal fabrication and finishing services to both the commercial (electronics and telecommunications) and defense industry markets.

A public company incorporated in 1970, Inventronics has three plants in western Canada: Edmonton, Alta.; Brandon,Man.; and Moose Jaw, Sask.; with a total production area of177,000 square feet. The company has a CAD/CAM engineering group in each location.

Turnkey facilities allow Inventronics to control both the quality and delivery of all products to the customer.

Custom Precision Sheet Metal Services

Inventronics has established a Quality Assurance Program meeting NATO specifications AQAP 4 and AQAP 6, as well as MIL I 45108A, an NC fabrication, an aluminum fabrication and welding, paint finishing, zinc plating, and aluminum anodizing. Two particular areas which may be of special interest to some customers are Inventronics' aluminum spot welding capacity (.160" thick to .125" thick), and its automated powder paint lines.

The company utilizes state-of-the-art manufacturing techniques, such as CAD/CAM engineering and manufacturing with a direct hook-up from engineering computers to equipment on the floor, resulting in reduced lead time, decreased costs and improved quality. Inventronics encourages customers to use its design and engineering expertise to assist in the development of new products or in the cost reduction of current products. "In our experience, this kind of team work almost invariably results in better design and lower production costs," says company marketing manager Grant. Shannon.

Complex and precise sheet metal fabrication requires precise equipment. Inventronics owns four CNC Turret Punch Presses, DNC's to computers in the engineering offices. PressBrakes all have multiple axis NC backgauges for accuracy,speed and elimination of multiple bending set-ups.

Quality welding of components, assemblies, chassis and cabinets are essential to the performance of a finished product. The Tig, Mig and Spot Welders, used by Inventronics in the manufacturing process, all conform to military welding equipment specifications and are periodically monitored to ensure their performance.

Painting can be done in both wet coat and powder coat, and a computerized system monitors paint colour for precise matching throughout a specific run, or from run to run. Anodizing is done in clear, gold or black. Silk-screening can also be accomplished in-house.

Inventronics can provide both electrical and mechanical assembly of customer products, to allow lower assembly cost or increased customer capacity. All the services required to produce a finished product for the customer are available in-house.

Just in time delivery is offered on high-volume recurrent orders, allowing larger customers to greatly reduce inventory, floor space and extra carrying charges. Inventronics also specializes in the design of control room consoles and stand-alone operations consoles.

Standard Products for Electronic Packaging

Inventronics produces a number of high quality, durable, aesthetically pleasing electronics packaging products. These include a heavy-duty Modular Electronic Cabinet series, a heavy-duty and light-duty Welded Relay Rack series, a Universal Data Cabinet series, a standard steel KnockdownRelay Rack series, and a heavy-duty aluminum Knockdownseries, as well as a number of standard accessories to support these products. All standard products are finished in a durable epoxy powder coat finish; products are shipped assembled to the customer.◆

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Technical Innovations through Product Research

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Microtel, Space Tel Cabinet

Sherritt Gordon Ltd.

A world of experience—an expanding expertise—a quality company

The scanning electron microscope and X-ray microanalysis assist researcher in the development of advanced industrial materials

Sixty years ago, Sherritt was a small Manitoba mining company. Today, the company is active in the production and marketing of fertilizers, chemicals and metals, the development and marketing of specialty metal products, and a world leader in hydrometallurgy technology. Sherritt has instituted a corporation-wide quality program with the commitment to "do it right the first time," and to deliver defect-free products and services to all customers.

Engineered materials for high performance applications

Specialty Metal Products produces nickel, cobalt, copper and composite powders through the application of the principles of pressure hydrometallurgy. These highpurity metal powders possess uniquely controlled particle size and shape. A major market for composite powders is in the manufacture of advanced coatings using thermal spray technology. Applications for these coatings are found in numerous industries. Sherritt's nickel/graphite composite powder is applied as an abradable seal that significantly reduces fuel consumption in aerogas turbines for today's airliners. For electronic applications, ultrafine nickel powders are used in gas discharge video displays, and copper powders are applied in multi-layer hybrid circuits.

Markets for these advanced materials are global. For example, powders are exported to manufacturers of commercial aircraft turbines in the United States, the European Economic Community and the Pacific Rim. A customer list would include such high profile companies as GE Aircraft Engines, United Technologies, Pratt & Whitney, General Motors Allison Division and Rolls-Royce PLC.

Quality fertilizer products

Sherritt manufactures, distributes and markets a broad range of nitrogen and phosphate fertilizers. Production facilities include highly efficient world-scale ammonia and urea plants, as well as smaller ammonia, urea, ammonium sulphate and phosphate facilities. Annual rated capacities of Sherritt's nitrogen fertilizer plants are 485,000 tonnes of ammonia, 40,000 tonnes of urea, and 140,000 tonnes of ammonium sulphate. Annual production generally exceeds rated capacity. Sherritt also operates phosphate fertilizer plants with an annual capacity of 120,000 tonnes.

Primary markets for Sherritt's fertilizers are western Canada and the U.S. Pacific northwest; products are also sold off-shore.

Sherritt Chemicals

The Special Chemicals group includes Thio-Pet Chemicals which manufactures chemicals for the oil and gas, mining, pulp and paper, water treatment and heavy water industries; United Chemicals which produces alum and a wide range of cleaning compounds; and the recently announced Albchem Industries Ltd. which will produce sodium chlorate. Chemicals produced at Fort Saskatchewan include: carbon disulphide and hydrogen sulphide, xanthate solutions for sulphide mineral flotation, sodium hydrosulphate for pulp mills and copper flotation, Vanox R (ammonium bisulphate) primarily used as an oxygen scavenger in drilling fluids, ammonium thiosulphate for photographic processing and specialty fertilizer formulations, and ferric sulphate (Triron R) which is used extensively as a toxic metal remover and coagulant in water treatment plants. Technology for the production of these chemicals is available on a non-exclusive basis through Sherritt's External Technology Group.

Sherritt refines metals and manufactures and develops coinage products.

The metals refining unit treats nickel and cobalt acquired from third parties and markets the metal output. The nickel refinery has a capacity of 55 million pounds and the cobalt refinery a capacity of 2.5 million pounds. Both facilities have generally operated close to capacity with materials supplied from a number of countries. Sherritt's nickel is marketed through Sherritt Metals Marketing Co.

The stainless steel market accounts for

approximately half of Sherritt's refined nickel sales with the chemical market, welding rod industry, powder metallurgy and foundries making up the balance. Forty per cent of Sherritt's nickel is sold in North America; Europe and Japan account equally for the remainder.

Sherritt markets its cobalt to the chemical, magnet, and powder metallurgical industries in North America, Europe and Japan.

Sherritt's coinage unit manufactures strip, coinage blanks and coins and markets them around the world. Product development has led to the introduction of unique coinage materials including Aureate-Nickel, used for the Canadian dollar coin and the Netherlands five guilder coin, and Nickel-Bonded Steel (N-B-S™) which is marketed to a number of countries.

Process and product technologies: a proven track record

Sherritt has been a world leader in pressure hydrometallurgy for over 35 years. The company has developed numerous processes for the recovery of nonferrous metals from ores, concentrates, mattes and residues. Sherritt's processes for nickel, zinc and gold production have had a large impact on acid rain reduction through the complete elimination of sulphur dioxide emissions into the atmosphere, while achieving significantly increased recoveries of primary metals and associated byproducts.

The company's unique hydrometallurgical process technologies have been used in the engineering and construction of over 20 commercial plants on six continents.

Sherritt has developed the ammonia leach process which recovers nickel, cobalt and copper from nickel concentrates, mattes, and other feed materials. The cobalt pentammine process treats cobalt-bearing materials to recover pure cobalt powder. The acid leach process involves pressure leaching of nickel and copper mattes to recover saleable metal products plus a high grade platinum group metal (PGM) concentrate containing any PGMs in the feed. Eleven commercial plants have been built on these processes in North America, Europe, Africa and Australia.

Sherritt zinc technology involves the direct pressure leaching of zinc and bulk concentrates and zinc-containing residues followed by conventional solution purification and electrowinning processes. The zinc process can be used for new plant applications or integrated into existing roast-leach plants. Significant cost savings accrue in pressure leaching compared to a conventional roast-leach plant, since the roaster, acid plant and conventional leach plant are not required. The outstanding advantage of Sherritt zinc technology is that it eliminates the primary environmental concerns of the zinc industry.

Currently, two commercial plants are operating using the Sherritt zinc technology. One is at Cominco Ltd. in Trail, B.C., and the other is at the Kidd Creek Division of Falconbridge Limited in Timmins, Ontario. A third commercial facility at Ruhr-Zink GmbH (Datteln, West Germany) is being constructed.

Sherritt sulphur technology produces elemental sulphur from sulphidic ores and concentrates. One application is in operation at Cominco's plant in Trail; a second application is being incorporated at Ruhr-Zink GmbH.

Sherritt has developed process technologies to recover gold from refractory sulphide materials such as ores, concentrates and metallurgical plant byproducts. The process eliminates sulphur dioxide emissions associated with conventional roasting techniques and converts the iron and arsenic to environmentally stable hematite and ferric arsenate, and the sulphur to gypsum.

The first commercial application of pressure oxidation to treat refactory gold ores was at Homestake Mining Company's McLaughlin Gold complex. The second application was at Sao Bento Mineracao in Brazil. The Porgera Project in Papua, New Guinea, and the METBA Project in Greece are being built utilizing Sherritt's gold technology.

Sherritt's expertise is rapidly expanding as it continues to lead in the development of new technologies to enhance resource recovery and protect the environment. As part of the commitment to this expansion, Sherritt has obtained a controlling interest in Rescan Environmental Services Ltd. and owns Bacon Donaldson & Associates Ltd., both of Vancouver, British Columbia.

Rescan has built a reputation in providing

Filtered light is used in the metallograph to show features of new materials for the aerospace industry

A research technician runs solvent extraction tests to separate cobalt from samarium using an organic extractant

environmental planning and engineering services to the pulp and paper, petroleum, mining, metallurgy and related industries. From the company's foundation in waste management services, Rescan has become a recognized authority in providing expertise in environmental impact assessments, hazardous waste treatment and control processes, environmental audits and risk analysis, establishing corporate environmental strategies, and industrial hygiene, occupational health and safety procedures.

Bacon Donaldson provides a wide range of services in the areas of mineral processing, hydrometallurgy and physical metallurgy. The company was established in 1972 as a small two-man engineering firm specializing in metallurgy. Today, the company is one of Canada's foremost laboratories, providing diversified lab testing, engineering, consulting and research services to local, national and international clients in business, industry and government.

Research and Engineering

TECHNOLOGIES YOU CAN BANK ON

Sherritt's research, development and engineering capabilities extend from the design of plant modification through to major new plant projects. In all projects, Sherritt professionals work closely with clients to ensure a high quality product, delivered on time and on budget. Sherritt engineering is based on a solid foundation of data built up over 35 years of research, development and plant operations. In designing commercial plants, Sherritt offers the client the benefit of scale-up and operating expertise developed in Sherritt's own operations and many major projects. That is why Sherritt describes the documentation provided to clients as "bankable".

Sherritt has an internationally acclaimed track record for the development and commercialization of advanced industrial materials. The company has commercialized a host of products—from composite powders used in the manufacture of aircraft jet engines, to high strength magnets—more than 100 distinct new products and 300 inventions. Nearly 2,600 Sherritt patents have been registered around the world.

WESTAIM

MATERIALS FOR THE FUTURE

Sherritt, in co-operation with the governments of Canada and Alberta, is undertaking the first major advanced industrial materials (AIM) initiative in western Canada. The initiative will be carried out under the auspices of a wholly-owned Sherritt subsidiary called WESTAIM Technologies Inc. The new organization will involve a world-class research and development centre focusing on the commercialization of advanced industrial materials and systems. A major objective of WESTAIM is to build a more substantial Canadian business presence in AIM through close collaboration among industry, academia, and government.

Advanced industrial materials are generally recognized as materials that have been engineered to have specific properties to meet the particular requirements of a market niche. The Canadian dollar coin blanks, produced by Sherritt, are an example of a composite metal advanced material with specific magnetic properties and physical characteristics. Sporting goods manufacturers will often capitalize on new advanced industrial composite materials developed for aerospace applications, and apply them to everyday products such as golf clubs, fishing rods, skis and racquets. Advanced industrial materials are recognized by the provincial and federal governments as an integral part of strategic long-term economic growth and diversification, that is, an "enabling technology".

WESTAIM will be led by Sherritt, and will provide ample opportunity for participation by other industrial allies. The form of participation will vary from project to project: it may involve joint ventures, partnerships or other forms of strategic alliance. The synergistic effects of pooling the resources and capabilities of strategic alliances between industrial partners will result in more rapid commercialization of relevant materials technologies.

A substantial increase in staff will be necessary for WESTAIM to become an international leader in advanced industrial materials. Highly skilled professional and technical personnel are required to augment the existing organization. An active recruiting program is currently underway for highly creative individuals with strong records of

achievement. WESTAIM opportunities exist for qualified individuals in materials, metallurgy, chemistry, and solid state physics, as well as other scientific disciplines. Candidates with experience in hydrometallurgy, physical metallurgy, powder metallurgy, coatings technologies, materials science or tribology, combined with a Masters or Doctorate degree are of particular interest, and are invited to submit applications.

When fully operational, WESTAIM will maintain a staff of approximately 200 scientists, researchers, technicians and support personnel in applied research and development aimed at the initial targets of aerospace, electronic, process and energy sectors of the economy.

The initial investment in WESTAIM research and development is projected at $140 million over the next five years. Industry will contribute $70 million, and the federal government and the province will each provide $30 million. The government of Alberta, through Technology, Research and Telecommunications, will provide an additional $10 million for the construction of new facilities for WESTAIM. Federal contributions, through the Western Economic Diversification Fund, the National Research Council, and the ministry of Industry, Science and Technology, will direct an additional $10 million in new funds towards technology development in Alberta. When the proposal was announced, deputy premier Don Mazankowski described WESTAIM as an "unparalleled opportunity which places Canada at the forefront of new economic and technological frontiers."

Initial WESTAIM projects will be conducted in existing Sherritt facilities and the recently completed Phase I building that includes approximately 32,000 square feet of offices and laboratories. Construction of the Phase II building (65,000 sq. ft.) to house major new materials laboratories is scheduled to start in the spring of 1990 and be complete by April 1991. Sherritt has designated that a parcel of land adjacent to the WESTAIM facilities would be available for a "Technology Park." It is envisaged that many smaller spin-off companies will be established, and these companies may wish to locate close by to take advantage of continuing technical and development services available from WESTAIM.

Dr. Bob Weir, Sherritt's vice-president of technology, says: "Many companies will come to WESTAIM to take part as allies. These will range from companies which will utilize the WESTAIM facilities and personnel to formulate and conduct their own research programs, and include alliances with customers to ensure the marketability of the advanced materials to be developed."

WESTAIM has been structured as a separate company with its own board of directors. It will be managed by industry and have a technical advisory committee represnting the stakeholders in the WESTAIM initiative. Under the leadership of Sherritt, through strategic alliances with industry, government, universities and Research Council Committees, WESTAIM will develop products demanded by the market.◆

A view of the cabinets in the fertilizer rack room. The rack room houses instrument cabinets containing process controllers and plant interlock circuits

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Fort Saskatchewan, Alberta, T8L 2P2
Phone (403)998-6911, Fax (403)998-6858

Fertilizer Division
Phone (403)426-3550, Fax (403)428-8960

Specialty Metal Products:
Phone (403)998-6902, Fax (403)998-6636

Technology Division
Phone (403)992-5050, Fax (403)992-5010

sherritt

The Laser Institute

Linking Lasers to Industry

Since its inception in 1984, the Laser Institute has provided contract research and development, consulting engineering, and custom laser materials processing to clients in a variety of industries.

"We have clients in the oil and gas, agriculture, defence, transportation, electronics, heavy equipment and automotive industries," says Dr. Don C.D. McKen, president and chief executive officer. "Our current activities are concentrated primarily in Canada. We are examining opportunities in the U.S. and Europe."

With a staff of 15, the Laser Institute supplies companies and individuals looking for enhanced methods of manufacturing. In its contract research and development, and consulting engineering roles, the Laser Institute specializes in three areas: laser materials processing, optoelectronics, and metrology and automation. "Our wide range of services includes research and development, feasibility studies, design, and prototype development and testing," says Dr. McKen, "allowing us to assist clients at any stage of product or process development."

Dale Allsop, P.Eng., operates a machine vision inspection system using laser light. The camera on the left records the object's dimensions, which are then transferred to the computer.

Jim Arnold, laser technologist, applies a weld overlay with the five-kilowatt carbon dioxide laser system (unique in Canada)

The Materials Processing Division concentrates on the machining capabilities of the laser. Laser power can be readily focused to high intensity to perform a variety of tasks. A wide range of materials such as metals, plastics, ceramics, composites and wood, can be cut accurately and economically.

The laser can also be used to weld, heat treat, and apply weld overlays. Heat treating is used to change the structure of metals to produce a wear-resistant surface. Weld overlaying or hardsurfacing, by metallurgically bonding a wear-resistant metal to a base metal, is also used to increase the life of components. Dr. McKen explains that the controllability of the laser is excellent, and heat input into the part is low. This results in minimal part distortion, decreasing or eliminating the need for machining after processing. Many methods of using the laser as a materials processing tool have been established, and new ideas and techniques are constantly being developed.

The Optoelectronics Division is mainly involved in the application of lasers to sense a variety of phenomena. Because laser light can carry information, it can be used to measure temperature, light, colour, flow, pressure, and many other physical properties. Laser sensing is particularly useful in such hazardous areas as gas or chemical plants, where electronic instruments or intrusive methods of sensing are undesirable.

In the Metrology and Automation Division of the Laser Institute, lasers are used to perform accurate measurements. For example, laser-based systems are used to measure the surface profile variations of welds to determine the weld's quality and corrosion rate. This technology can also be used to inspect pipe threads. The division also develops machine vision systems to provide quality control on production lines—monitoring products as diverse as aluminum beverage cans and coniferous tree seedlings.

In its custom laser materials processing role, the Laser Institute affords an excellent chance for clients to assess the advantages of lasers in cutting, welding, heat treating and weld overlaying. "It also provides the opportunity for the small or low volume manufacturer to benefit fully from the unique advantages of laser processing, where in-house installation of equipment may be cost prohibitive," Dr. McKen states. With the assistance of the Laser Institute, companies can make the connection with laser technology and take advantage of its unique capabilities. ❖

The Laser Institute
9924 - 45 Avenue
Edmonton, Alberta, T6E 5J1
Phone (403) 436-9750, Fax (403) 437-1240

144, 6815 - 8th Street N.E.,
Calgary, Alberta, T2E 7H7,
Phone (403) 295-3500, Fax (403) 295-0732

Suite 801, 90 Sparks Street,
Ottawa, Ontario, K1P 5B4
Phone (613) 237-2615, Fax (613) 563-9934

THE LASER INSTITUTE

ALBERTA RESEARCH COUNCIL

ENA

Alberta Telecommunications Research Centre

Alberta Microelectronic Centre

The Alberta Microelectronic Centre (AMC) is funded by the provincial government to promote activity in the electronic industry, increase public awareness and assist in skills development.

Short term results are gained through programs aimed at the commercial sector to assist with the research, development and commercialization of existing products and new ideas. The university programs are targeted for longer term goals. They include collaboration on research projects, support for graduate students, and undergraduate classes.

The AMC's industrial clients benefit from educational programs and consulting services. Educational activities include seminars and workshops designed to increase awareness of technological development. Seminars are an effective way to introduce new technologies to a broad range of Alberta companies. If a company has a need to proceed further with a new technology, the AMC can help with feasibility studies and design projects. These consulting services are intended to assist emerging electronics companies in implementing new technological ideas and products.

In conjunction with the Universities of Alberta and Calgary, the AMC offers courses in semi-custom microchip design. Students from Electrical Engineering and Computer Science attend classes at the Calgary office and use the sophisticated CAE tools. The intention is that, when these students go on to take jobs in industry, they will transfer this technology to their new companies. The AMC is also working with the universities to help commercialize the results of research programs. The AMC collaborates with the University of Alberta in sensor research, and the University of Calgary in high temperature and pressure instrumentation research.

The AMC has the tools and expertise to cover a broad range of electronic technologies. A primary focus has been on Applications Specific Integrated Circuits (ASIC). The Calgary Centre has comprehensive ASIC design tools, and the Edmonton Centre contains an ASIC fabrication facility. In addition to microchip expertise, the AMC staff has considerable expertise in electronic design and Printed Circuit Board (PCB) design and layout.The goal of the Electronics Network of Alberta.❖

Alberta Microelectronic Centre

Transferring electronics technology

The Alberta Microelectronic Centre
200, 3553 - 31st Street N.W.
Calgary, Alberta, T2L 2K7
Phone (403) 289-2043

318, 11315 - 87 Avenue
Edmonton, Alberta T6G 2C2
Phone (403) 492-3914

The Electronics Network of Alberta

Alberta is moving into the 21st century and advanced technologies are providing new vistas for economic diversification.

Industry, the research community and government, working closely together, have created the Electronics Network of Alberta as an integral part of the infrastructure required to support and nurture entrepreneurs in key advanced technology sectors.

The Electronics Network of Alberta is a group of strategically linked applied research and development and services centres established to meet the technological support and growth needs of Alberta industry. The Network is unique in North America, and provides industry with information, technology and support from a pool of experts in microelectronics, telecommunications, lasers, information technology, expert systems, advanced manufacturing, and testing and evaluation. Client companies participating in projects at one or more centres can access many different technology skills and obtain training and technology transfer to apply these advances to specific business needs.

Members of the Electronics Network of Alberta are: the Alberta Research Council, The Laser Institute, the Alberta Microelectronics Centre, the Alberta Telecommunications Research Centre, and the Electronics Test Centre. These core institutions are linked to the research and development capabilities of the Universities of Alberta and Calgary.

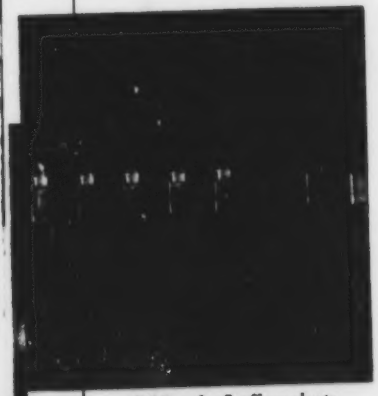
The goal of the Electronics Network of Alberta is to keep the province's companies competitive in the global marketplace. Worldwide research advances and their applications to industry are occurring at an ever increasing rate, and the Network provides companies with the secure technological base required in today's business arena. The Network opened an office in Ottawa in 1989 to improve liaison between Alberta's technology communities, the federal government and eastern Canadian industries.❖

ELECTRONICS TEST CENTRE
SPONSORED BY THE ALBERTA RESEARCH COUNCIL

For more information on the facilities and services offered by the Electronics Network of Alberta, contact:
Corporate and Public Relations
Alberta Technology, Research and Telecommunications
12th Floor, 10909 Jasper Avenue
Edmonton, Alberta, T5J 3M8

Alberta Research Council

Advanced Computing & Engineering: *Staff monitors the assembly operation of the Advanced Manufacturing Demonstration Facility*



Oil Sands: *Staff conducts technical and environmental investigations of the tailings sludge produced during bitumen recovery*

Technology development and environmental enhancement go hand in hand. In working with government and industry to diversify the economic base of the province, the Alberta Research Council has traditionally focused its efforts on "sustainable development: to maintain the balance between development of our natural resources and protection of the environment. A provincial crown corporation, the Alberta Research Council's staff of 600 makes it the largest of Canada's provincial research organizations. Its mission statement outlines its role: to advance the economy of the province by promoting technology development, performing applied research, and providing expert advice, technical information and scientific infrastructure that is responsive to the needs of the private sector and supports activities in the public sector.

Founded in 1921, the Alberta Research Council is now approaching seven decades of applied research and development, and technology transfer to the private sector.

Multidisciplinary approach to pressing problems

The Alberta Research Council concentrates on two broadthrusts: resource technologies and advanced technologies. Working individually or in teams, researchers pool their expertise and experience to provide clients in Canada and around the world with innovative solutions to practical problems.

The Alberta Research Council's headquarters, located in south Edmonton, are the site of three major facilities: the Electronics Test Centre, forest products pilot plant and testing laboratory, and a biotechnology pilot plant.

The Electronics Test Centre addresses the needs of the telecommunications and electronics sectors by providing "one-stop" testing and engineering development capabilities for local, national and international electronics manufacturers. The forest products pilot plant and testing laboratory offers Alberta manufacturers of panel products arange of services vital to their market needs. Perhaps the most visible illustration of the ability of the Research Council to look to the future and adapt to a rapidly changing world is its biotechnology department. Today, the Alberta Research Council has in place the best equipped, publicly owned pilot scale-up facility in Canada and is rapidly acquiring an international reputation for its expertise within the biotechnology community.

Resource Technologies

There are very few places in the world that offer the same forestry research and development capability as the Alberta Research Council. The Research Council's testing lab expedites the acceptance of Alberta forest products by testing to national and international standards; it participates in national standards development and works closely with individuals and other laboratories to keep abreast of international developments.

In one project, the forestry department worked with Edmonton-based Western Archrib, a manufacturer of glued laminated beams. As a result of the research, the company was able to substitute Alberta wood for imported Oregon Douglas fir in its product.

Scientists in the oil sands and hydrocarbon recovery department are using CT technology—not to examine the human brain, but to unravel the mysteries associated with enhanced oil recovery techniques. Using the sophisticated X-ray technology to examine oilfield cores, researchers have opened a whole new window on bitumen recovery research.

A joint research project between the coal and hydrocarbon processing department and the Electric Power Research Institute of Palo Alto, California could produce double benefits for Alberta and Canada by offering an economical upgrading solution for both lower quality coals and heavy oils. The project has attracted the participation of 18 private sector resource and utility companies in Canada and the U.S. The research involves agglomeration of low rankcoals with heavy oil and bitumen, designed to rid coal of large amounts of mineral matter and water (which increase transportation costs and reduce boiler efficiency). The process is designed for use with western Canadian low rankcoals and eastern Canadian bituminous coals.

Advanced Technologies

With numerous artificial intelligence (AI) projects either under way or completed, the Alberta Research Council's advanced computing and engineering department is playing a key role in linking Alberta's high technology industries with its resource industry. AI projects already completed by the department include an expert system for well log analysis and a computer-based training system. Both systems were developed under joint research ventures with industry and are now on the market.

A California biotechnology firm has become a user of the Research Council's Biotechnology Pilot Plant—and the ultimate result could be a new Alberta industry. Scientists are scaling up to pre-production quantities entomogenous nematodes (microscopic insect killing worms) for BIOSYS, a biological pest control company with headquarters in Palo Alto. The company contacted the Research Council because it was aware of the pilot production plant's facilities and expertise in scale-up.

Corporate Programs

A Joint Research Venture program was introduced in 1983, and has been enthusiastically endorsed by industry. By providing a vehicle for Alberta industry to participate incost-shared research projects, the Research Council helps to accelerate the commercialization of new products, processes and services being developed by these firms. Some two dozen Alberta companies have been helped through joint research ventures, from small manufacturing firms to companies such as Calgary's DataSpan Technology.

The National Research Council's Industrial Research Assistance Program provides assistance in developing innovative technology to the commercial stage. Administered in Alberta by the Alberta Research Council, this program annually helps thousands of small Alberta firms that have identified markets, but lack the finances or technical support they need to bring their technology to fruition Industrial technology advisors are located in Edmonton, Calgary, Lethbridge and Red Deer to provide a confidential in-plant technical support service to a broad range of companies.

Opening doors for Alberta Industry

The Alberta Research Council continues to foster international links with research institutes and industry as a means of encouraging technology transfer both into, and out of Alberta. Because foreign governments often prefer to negotiate with other governments, the Research Council as a crown corporation is often able to serve as a "door-opener" for Alberta industry. Through its scientific network, the Research Council has been developing and promoting exchanges that see its staff on secondment to foreign scientific institutions and governments in China, Japan, Indonesia, Jordan and in Europe.

On April 9, 1990, the Alberta Research Council and the Italian research company Eniricerche of Milan and Rome signed a co-operative agreement as a step toward collaborating in research and development at laboratory and pilot plant scales. Development of new materials such as ceramics, coatings and membranes; management of industrial waste; removal of organic sulphur from fossil fuels; methane utilization; development and application of sensors for resource industries, and medical and environmental applications, are among the areas of mutual interest. The two organizations have established a committee to set research objectives and priorities, and assess research and development requirements.

These ties with other countries are becoming more important as Alberta and Canada expand their international commerce. The Research Council will continue to foster international links which can promote technology transfer abroad and provide access to foreign technology needed by Canadian industry.◆

ALBERTA RESEARCH COUNCIL

Alberta Research Council headquarters and laboratory complex

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250 Karl Clark Road,
Mailing address:
PO Box 8330, Station F
Edmonton, Alberta, T6H 5X2
Telephone (403) 450-5111

Oil Sands and Hydrocarbon Recovery:
1021 Hayter Road,
Mailing address above
Telephone (403) 464-9212

Oil and Hydrocarbon Processing:
Oil Patch Drive
Devon, Alberta
Mailing address:
PO Box 1310,
Devon, Alberta, T0C 1E0
Telephone (403) 987-8111

Natural Resources:
Terrace Plaza,
4445 Calgary Trail S.
Edmonton, Alberta
Mailing address:
PO Box 8330, Station F
Edmonton, Alberta, T6H 5X2
Telephone (403) 438-7555

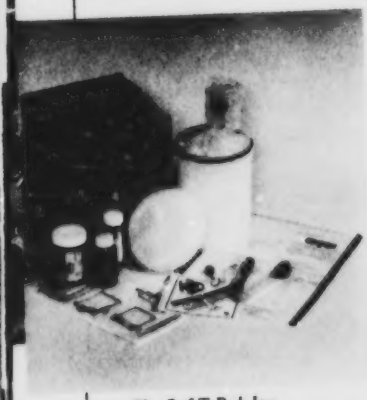
Alberta Research Council Regional Office:
3rd Floor, Digital Building
6815 - 8 Street N.E.
Calgary, Alberta, T2E 7H7
Telephone (403) 297-2600

Industrial Technology Advisor Network:
203, 714 - 5 Avenue S.
Lethbridge, Alberta, T1J 0V1
Telephone (403) 381-5370

Provincial Building
4920 - 51 Street
Red Deer, Alberta, T4N 6K8
Telephone (403) 340-5300

Saf-T-Pak

Safely shipping biological samples



The Saf-T-Pak Inc. Packaging System eliminates the requirement for all individual shippers to have their own packages submitted for testing and approval

When the average person hears the term "dangerous goods," they are more likely to think of flammable materials or toxic chemicals—not another potentially hazardous substance: infectious biological specimens.

Whether human or animal, infectious biological specimens (blood, urine or tissue samples) are subject to stringent shipping regulations. Mutant organisms formed by recombining DNA also fall under this category. The United Nations has set forth a series of recommendations; the International Civil Aviation Organization has also issued instructions (usually handled by the International Air Transportation Association) and the U.S. Public Health Service has vigorous restrictions on how "etiological agents" (any viable micro-organism or its toxin which causes, or may cause, a human disease) may be transported. In Canada, shipping infectious organisms falls under the "Transportation of Dangerous Goods Act"; the province of Alberta has also enacted its own dangerous goods transportation legislation which is substantially similar to the federal act. All specify that when shipping or transporting infectious biological specimens, they must be packaged in an approved container. Penalties for non-compliance are stiff.

An Edmonton company, Saf-T-Pak Inc., has developed certified packaging for the transportation of diagnostic specimens and infectious substances. The Saf-T-Pak Inc. System meets or exceeds all national and international standards.

The Saf-T-Pak System

This packaging system, meeting the Canadian General Standards Board standard 43-GP-125 MP, is deceptively simple, yet it and its contents withstand the "torture tests" necessary for certification.

The patented Saf-T-Pak Inc. system consists of a specially designed corrugated cardboard carton with additional cushioning. Inside sits a plastic secondary container with a unique leak-proof design. Samples are wrapped in cushioning material and packed inside the secondary container. In the bottom of the container is a disc of highly absorbent material to absorb the contents of sample vials in the unlikely event of leakage.

The entire system is economically priced. It comes pre-assembled, ready for shipping. No shippers' materials or tools are required (in fact, there is a self-adhesive sealing strip on the carton, with a peel-and-stick hazard label included). The plastic container is reusable, and refurbishment kits are available for a reasonable fee. The Saf-T-Pak Inc. System is delivered in case lots containing twelve units.

In order to meet certification standards, the Saf-T-Pak Inc. System was subjected to a series of rigorous tests. First, 60 packages were filled with vials containing a total of 50 ml of dyed water (the maximum liquid contents for infectious substances allowed in one package under Canadian law) and prepared for shipping. Each of the 60 cartons was closed and sprayed with water for half an hour, then it was dropped onto a concrete floor from a distance of nine metres—repeatedly, on all sides and one edge, for a total of 60 drops in all. After the drops, the packages were subjected to an impact test: being hit with a steel bar weighing seven kilos from a distance of one metre. The Saf-T-Pak Inc. System also survived severe pressure tests (95 kPa) and vacuum tests, and withstood temperature extremes of -40°C to 55°C.

Through it all, the contents of the container remained intact; none of the primary containers leaked.

The plastic container is manufactured in Calgary, and assembly is completed in Edmonton by disabled individuals atthe Western Industrial Research and Training Centres. "We can produce 2.5 million units a year under our present system," says Saf-T-Pak Inc.'s president Alma McConnell. "If demand requires, we can double our production very quickly."

While the system appears simple, like all good ideas it took several years to refine and perfect. "We had to develop our own container, on which patents in the U.S. are granted, and in Canada and Europe are pending," explains Bert Spencer, vice-president, manufacturing, because we found that existing plastic containers would not pass the necessary tests. We found that they had a "shoulder", making it difficult to remove cushioned samples, or that the threads weren't deep enough, so the container would leak under pressure. So we created our own."

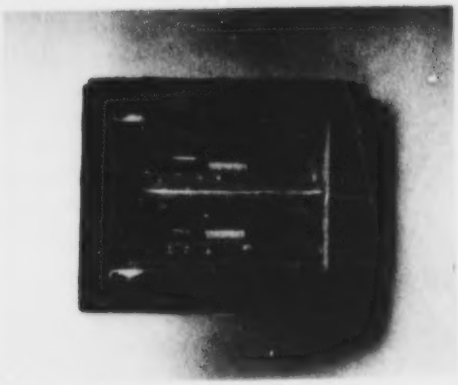
Putting safety procedures into practice

Canada's airlines are adamant about ensuring that infectious substances are properly contained and marked incompliance with regulations. According to Mr. Spencer, shippers who are transporting samples by surface will followsuit. "Research indicates that some technicians used to handling samples treat them in what could best be described as a cavalier manner. People think that because the samples are not travelling by air, the regulations don't apply to them. And when a sample is taken and sent for diagnosis, it does not fall under the dangerous goods regulations. When a test is made and it's discovered that an infectious disease is present, hepatitis B, for example, it may be sent to a public health lab for confirmation, since it's a reportable disease. Yet, though the institutions know or suspect that an infectious disease is present, we've found that many of them are marking the samples as diagnostic specimens, and not putting them in approved containers."

Imagine a worst-case scenario: taxi cabs and couriers are often used to transport samples, and it's not unheard of for drivers to put a specimen in their pockets, or place it in a paper bag or cardboard box on the front seat of the car. What happens if that car is in an accident and the vials break? Not only is the driver at risk, but so are any emergency response personnel who may come into contact with these specimens, or any person obliged or kind enough, to render assistance.

The Red Cross Society is now screening blood for AIDS, hepatitis B, and syphillis. By the end of June 1990, they will also be screening for hepatitis C and human-T-lymphotrophic virus 5, another retrovirus that has appeared in Japan and areas of the Caribbean, causing a type of lymphoma and neurological problems. Dr. Bob Turner of Edmonton's Red Cross points out that less than 1% of the samples screened for these diseases in Alberta in the last three years has tested positive; nonetheless, he advocates careful packaging of specimens for the peace of mind of people handling them, and to ensure that the samples arrive intact. "The percentage of infectious specimens is much higher for others in the industry," adds Mrs. McConnell, "and many do not adhere to the high standards of the Red Cross."

Saf-T-Pak Inc. provides training for handling and shipping dangerous goods, and has taught safe handling procedures to airline and transportation personnel. "Our company's aim is to reduce the risk," says Mrs. McConnell. "When you think of the many millions of samples handled by public and private institutions each year, it's imperative that we minimize any risk to public health and safety."◆



The system accommodates a range of specimen containers. No additional shippers' materials are required

Saf-T-Pak Inc.
10450 Mayfield Road
Edmonton, Alberta, T5P 4P4
Phone (403) 486-0211, Fax (403) 486-0235

7650E Evans Road, Suite C
Scottsdale, Arizona, U.S.A 65260
Phone (602) 998-1832, Fax (602) 483-1069

SAF-T-PAK INC.

Got a Bright Idea Almost Ready to Fly?

If your idea is related to medical research or patient care you may be eligible for a grant from the Alberta Heritage Foundation for Medical Research.

AHFMR has a Technology Transfer Program to help good ideas take flight. Grants are given to scientists and business people in Alberta universities and Alberta-based businesses.

Funds can be used to build prototypes, evaluate markets, develop production methods, start up manufacturing and set up clinical trials.

Grants of up to $500,000 are available through the newest phase of the Technology Transfer Program called "The Alberta Medical Innovation Plan".

Bright ideas funded so far:

- A promising drug for hepatitis B
- A sleep mask for the "snoring disease"
- A geriatric bed
- A catheter to clear blocked arteries
- An innovative knee prosthesis
- A computerized system to manufacture medical research instruments
- A multiyag surgical laser
- A computer-aided speech prosthesis
- A new method of producing starting materials for AIDS drugs

For more information contact:
The Alberta Heritage Foundation for Medical Research
3125 ManuLife Place
10180-101 St.
Edmonton, Alberta, Canada
T5J 3S4

Financed by an endowment from the Government of Alberta, AHFMR contributes about $35 million annually to medical researchers at the Universities of Alberta and Calgary.

NAIT

Training tomorrow's technologists; meeting industry's needs today

The Northern Alberta Institute of Technology (NAIT), located in Edmonton, Alberta's capital, has served as one of Canada's foremost technological training institutes since 1963.

Sixty-five diploma (2-year) and certificate (1-year)programs in the realms of engineering, resource and industrial technologies, business and computers, health and medical sciences, hospitality services, and applied arts are offered at NAIT. A number of NAIT's programs have been accredited by provincial and national occupational and professional organizations.

More than 90% of NAIT graduates are employed within four months of graduation. This placement is the result of NAIT constantly being in touch with the needs and expectations of business and industry, and effectively applying the feedback to instructional planning. NAIT keeps pace with the outside world and technological advances in it, as much to ensure quality programming for its students, as to provide technical expertise to business and industry.

In 1984, NAIT established the Office of Applied Research and Product Development to help domestic and international businesses bridge the gap between pure research and commercialization. Through this office, NAIT offers practical approaches to specific technical and business problems encountered by industry, and can assist companies in their searches for funding sources, provide technical advice and link companies with other relevant organizations.

NAIT further aids business and industry by providing specialized instructional materials development and design, such as test panels, video training packages and interactive computer training packages. Further help is provided through prototype and process design, development analysis and testing; computer software development and assessment; industrial engineering support; market analysis and standardized procedures.

NAIT has a talented and diversified faculty with extensive technological, industrial and business experience. The Institute's laboratories and facilities are state-of-the-art, giving NAIT the resources to work with innovative firms in pursuit of technical improvements for their products and processes.

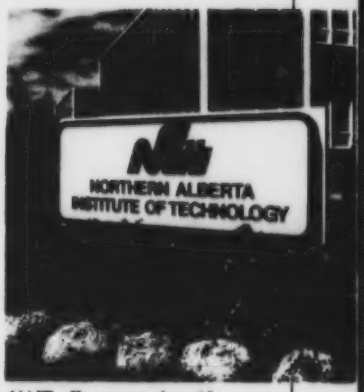
Customized Training is one of the many programs offered to business and industry through NAIT's Continuing Education Division. Customized training programs are tailored to the specific needs of a particular business client, and can help a company improve efficiency, upgrade technical competence, improve work methods, and teach or upgrade management skills. The program's flexibility allows classes to be taught on campus or at the client's work site during the day, in the evening or on weekends. Continuing Education also offers over 700 courses for part-time learners.

NAIT's reputation for excellence extends well beyond Alberta's borders. NAIT is currently involved in projects for technical, business and industrial training in more than ten countries, and has recently signed an agreement with the Alberta Research Council for initiatives in new engineering technologies.

Like any business, NAIT must keep pace with change to remain successful. The institute is experiencing a growing space shortage, brought on by increasing enrollment, rapidly advancing technology, and government funding cutbacks. Despite the shortfall of space, NAIT must remain competitive in a world in which technological training institutes are being challenged to play an increasingly important role.

In response to this challenge, NAIT has devised a long-term, large-scale Campus Development Plan. Among the plan's objectives is the construction of a $39-million health and medical sciences training facility near the NAIT maincampus. The 15,570 square-metre facility will contain the most advanced laboratories and classrooms, an auditorium, lecture theatres, student amenity areas and more. The NAIT Foundation has several fundraising initiatives underway to finance this worthwhile project.

Because of its positive and mutually beneficial relationships with industry, NAIT is able to enjoy a pre-eminent position as one of the best equipped technical training institutions in the country.◆



NAIT offers more than 65 different full-time programs, 22 apprenticeship programs, and some 700 part-time study programs and courses

Practical, hands-on training provides NAIT students with the knowledge and experience business and industry need to remain competitive

Career Training Information:
Registrar, Phone (403) 471-6248
Fax (403) 471-8583
Institute Information:
Marketing & Public Affairs,
Phone (403) 471-7707
Fax(403) 471-7533
Applied R&D Information:
Phone (403) 471-7524
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AGT's network management centre is a showcase of network management technology, providing 24-hour surveillance.

AGT

AGT—Alberta Government Telephones—links Albertans and Alberta business to friends and associates across the street, across the country, and around the globe. But AGT provides much more than telephones—advanced telecommunications are part of the fabric of society. Using computer network, making an automated bank deposit, buying a lottery ticket, setting a security system, even receiving a broadcast signal—all depend on telecommunications. And Albertans depend on AGT.

Alberta's primary supplier of telecommunications and information management systems is a key player in Alberta's burgeoning technology sector. As Canada's third largest telecommunications company, AGT generates over $1 billion in annual revenues and employs more than 12,000 Albertans.

Providing affordable universal telephone service was the company's founding mandate when it was established in 1906. Since then, AGT has evolved from telephones to telecommunications with a network that reaches into every corner of the province, providing advanced products and services to 2.4 million Albertans. In every area of telecommunications, AGT has led the way with mobile systems, microwave transmission, buried cable, fibre optics, and digital switching.

Through a number of subsidiaries established to foster technology development, AGT markets its expertise around the world. Alta Telecom International Ltd. (ATI) provides consulting services and specialized systems overseas, and Alta Telecom Inc. markets similar services in the United States. AGT also owns NovAtel Communications Ltd., Canada's only manufacturer of cellular telephone terminals and systems.

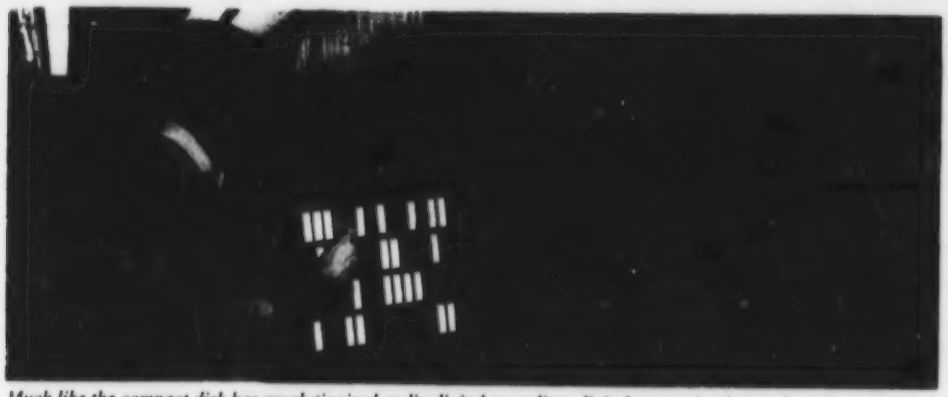
Telecommunications for tomorrow

The power of telecommunications is in the network, and AGT is a world leader in network expansion. Extending across the entire province—some 660,000 square kilometers, including remote northern regions—AGT's network represents an investment of over $3 billion, and an engineering feat that has won international recognition.

AGT is aggressively improving the network's capabilities. The company has initiated one of the largest modernization programs of its kind — to completely replace traditional analogue exchange technology with digital technology in the provincial system by 1992. The AGT network of today is a sophisticated 'superhighway', providing the optimum level of reliability, speed, and access — and the ability to provide a vast array of services including high-speed data transmission, home shopping, home banking and home monitoring.

In 1989, AGT introduced customers to a new dimension of service, — customer control. Control over who is calling and how the call will be answered, with features such as calling number display, call tracing to name only a few.

The company has also established a leadership position in the use of fibre optics. Placement of fibre into the network is a priority. Today, most of AGT's main trunk routes and many connection routes between switches are fibre optics. With a single pair of glass fibres able to carry 16,128 conversations compared to 600 pairs of copper wire able to carry only 14,400 conversations, AGT's network will have the capacity to carry even the heaviest traffic at the speed of light.



Much like the compact disk has revolutionized audio digital recording, digital processing has reshaped telecommunications. AGT is aggressively building Canada's first fully digital network, scheduled for completion by 1992.

Through the Integrated Services Digital Network (ISDN), AGT is further revolutionizing business communications, providing a single "pipeline" for simultaneous transmission of phone, FAX, video and computer screens thousands of miles apart.

Research and development

AGT is intensifying its role in the development of information technology and processes. The company has established an impressive knowledge base within its own research and development division, in addition to being an active contributor to several joint research ventures. A sponsor of the Alberta Telecommunications Research Centre and a founding shareholder of the Canadian Distance Learning Development Centre, AGT is playing a key role in developing Alberta's technology sector.

In September 1989, AGT began an Expert Systems Apprenticeship program designed to introduce expert systems echnology and pplications within the company. Expert stems are synonymous with artificial telligence, and are an important element in mputer applications. The expert systems ogram is run by Digital Equipment Canada EC)Ltd., and AGT is the first company in the rld to customize DEC's training program and e first to have DEC deliver in-house training. EC's program is usually operated from the rtificial Intelligence Centre in the U.S.

Research and development will continue to eep AGT at the leading edge of technology. Currently, the leading area of funding is hanneled toward the development of self-healing networks, with work also underway in areas involving fibre optics, distance education, wireless communication, voice recognition, and digital integration of services. AGT is also forging stronger ties with private sector entrepreneurial companies such as Idacom Electronics Ltd., Myrias Research Corporation, and Jade Simulations International Corporation.

With a focus on the future, and a solid foundation of proven innovation and leadership, AGT is positioned to play a primary role as Alberta—indeed the world—explores a new high-technology frontier.◆

AGT

For further information please contact:

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(403) 493-4730

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Edmonton , Alberta
T5J 0N5

AGT accomplished a world first in the use of high-capacity fibre optics in 1981. By the mid-1990's, all switches will be served by fibre optics.

High-Tech Exports Mean the World to Alberta

Alberta exporters are going high-tech

Alberta's high-tech exports reach markets from Malaysia to Iceland.

***Elzinga:** 21st century looks bright for Alberta*

After two decades of economic diversification efforts, more and more of the province's export starts are companies at the frontiers of advanced technology. In fact, Alberta is now recognized as one of the most highly developed and technologically advanced regions of the world.

With the 21st century just around the corner, this should come as especially good news to Albertans. In the rash of economic forecasting brought on by the approaching millenium, one message rings out loud and clear: the future belongs to the technological "haves".

"Alberta is well-positioned to take on the challenges of the high-tech, globally competitive 21st century," says Alberta's minister of economic development and trade, Peter Elzinga. "Alberta's exports continue to expand at a recordbreaking pace. And more and more of our 'export stars'—the companies we recognize with our annual Export Achievement Awards—are at the leading edge of advanced technology."

These include such high-tech pioneers as Willowglen, a world leader in the design of SCADA (Supervisory Control and Data Acquisition) systems; Interra Technologies, developer of innovative computer-oriented data-processing and collection systems; Western Research, a manufacturer of process gas analyzer systems and instrumentation; Westronic Inc., designer of microprocessor-based remote terminal units; Keyword Office Technologies, an information systems company on the cutting edge of document interchange applications; Datap Systems, a pioneer in telecommunications networkmanagement systems; and NovAtel Communications Ltd., a manufacturer of cellular telephones.

All of these companies have carved out a healthy share of the world market from Malaysia to Iceland. "These companies are proving that Alberta can compete globally in the fast-paced technology industries by developing new products and finding new markets," Mr. Elzinga says. "This is essential for a trading province such as Alberta. We are vitally dependent on gaining access to international markets in order to expand and diversify our economic base."

Mr. Elzinga points out that Alberta's economy is"stronger and more diverse than ever before." The province's gross domestic product reached $67.2 billion in 1989. Approximately 20% of that figure, or $14 billion, represented exported goods and services. Roughly 250,000 Albertans are employed, either directly or indirectly, as a result of international trade.

Mr. Elzinga attributes Alberta's success in the high-tech olympics to a unique partnership among the private sector, the university and research community, and the provincial government.

"This collaborative strategy has proven extremely effective in creating a superb environment for research, development and marketing of advanced technologies," he says. Alberta now boasts approximately 1,200 advanced technology firms, employing more than 50,000 people.

The government's role in bringing this about has been to provide support while following the lead of the private sector., Mr. Elzinga says. "Once business has established the direction, government policy can support and enhance its competitiveness and encourage further development."

The government's supportive efforts have included establishment of the Alberta Heritage Savings Trust Fund; maintaining a competitive tax regime with business and manufacturing rates among the lowest in Canada; building an extensive infrastructure in transportation, communications, education and health care; and developing world-class facilities in science and technology.

The government also assists exporters and would-be exporters with a variety of international trade programs aimed at increasing their competitiveness in the international marketplace.

"We help them prepare for that big step out into the global market, and once they're out there, they know we're behind them 100 per cent," says Mr. Elzinga.

One look at Alberta's high-tech export stars shows the strategy is paying big dividends.◆

You'll find innovation at work in some very surprising places in Alberta, as the goal of a diversified economy has become a reality over the past two decades. We're determined to reach even higher over the next ten years - to build on this momentum. To set new directions for diversification and growth.

TOWARD 2000

Alberta Economic Development and Trade is teaming up with business leaders and industry members - joining forces with educators and researchers throughout the province. As this generation of Albertans builds a better way of life for the next, we're setting our sights on success. We're shaping Alberta's future, as we work together toward 2000.

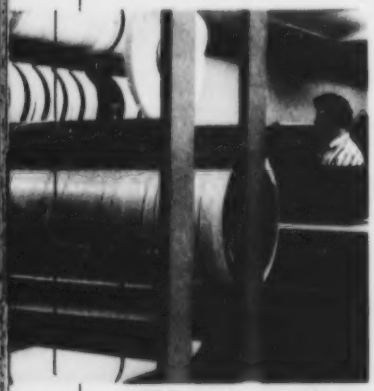
The sky's the limit for advanced thinking in Alberta's aerospace industry - Calgary's Intera Technologies Ltd. is a partner in the Radarsat project, which will see Canada's first earth observation satellite launched in 1994.

Alberta
ECONOMIC DEVELOPMENT AND TRADE
Hon. Peter Elzinga, Minister

Alberta Economic Development and Trade, Industry Development Branch, 10th Floor, 9940 - 106 St., Edmonton, Alberta T5K 2P6. Tel: (403) 427-2005 • Fax: (403) 427-5924

ACTC

The Cultivation of Excellence



ACTC's on-site computing facility

Team discusses software engineering design

Established originally as the "Advanced Computing Technology Centre" at the University of Calgary with a staff of four software engineers, ACTC Technologies Inc. is today a flourishing international software engineering company. ACTC is a shining example of technology transfer in Alberta, and is owned by the University of Calgary, Bull HN Information Systems Inc., and ACTC employees.

ACTC offers a unique set of skills to the computer marketplace, having expanded from its original focus of being a custom software engineering company for operating systems software, to being a major centre for conversion and migration to UNIX based systems.

Dedication to quality has brought a group of select individuals to ACTC Technologies Inc., creating an infrastructure of talent and expertise. ACTC's academic roots continue to provide direct access to the aptitude and ability graduating from all major Canadian universities. Specific skills and expertise in the area of operating systems in general and UNIX in particular, have put ACTC in a very advantageous position for the marketplace today and into the future. Of specific significance to ACTC's success is its specially designed project methodology. Using this technique, ACTC has gained an international reputation for quality product delivery.

The interdependent network of ACTC professionals defines their extensive range of expertise in operating systems development and support; programming language development, maintenance and enhancement; personal computer support environments; data communications; math library development and enhancement; supercomputing software technology; data base design, implementation and support; and Open Systems (UNIX) engineering.

The culture of ACTC is a result of the leadership that has successfully taken ACTC from its humble beginning to a company that today has over 60 employees. Over two centuries of combined experience and scholastic achievement is built into the management of ACTC Technologies Inc. Dr. Ron George (president and C.E.O.), Mr. Arun Gatha (executive vice-president and C.O.O.) and Mr. Brian Westcott (vice-president, technical operations) have directed ACTC since the beginning and continue to provide dynamic leadership and direction.

To ensure that ACTC establishes and maintains an active profile in the technology community at large, the company encourages all team members to take an active role in organizations such as CIPS, Calgary Council for Advanced Technology (C-CAT), Canadian Advanced Technology Association (CATA) and the Association of Computing Machinery (ACM).

ACTC's success is a result of very careful project design and implementation in conjunction with the client. Working hand in hand with the client, top level ACTC analysts develop a well defined functional specification for each project, within the parameters of time and budget. The appropriate match of people and process is essential to the success of each project. In conjunction with the attention given these choices, ACTC has implemented a customized matrix—Project Structure. The outcome of exceptional management is a record for being "on-time" and "on-budget" in excess of 95%.

To maintain and emphasize ACTC's commitment to excellence, a corporate Software Engineering Review Board was established in 1989 to define and formalize its software development environment and related procedures. Further, ACTC provides funding for employee professional development and for courses, seminars, and conferences specifically related to project work—nurturing the concept of growth and advancement.

ACTC has developed quality relationships with a number of major international computer vendors including IBM, Bull HN Inc., Control Data Corporation, and Sequent Computer Systems. Additionally, specific customer relationships have been established with a number of major Fortune 500 companies including the Ford Motor Company and General Motors Corporation. The magnitude of activity that ACTC undertakes on behalf of its clients is best reflected in the fact that almost all contracts have required between 30 and 250 person-months of engineering effort.

Having established itself as a quality system software engineering company and as a major migration and conversion centre, ACTC is committed to constant market and technology examination in order to maintain a competitive edge. A talented pool of expert consultants and educators whose understanding and vast knowledge of past and future technology allows ACTC a unique and prominent position in the marketplace. With the industry moving to Open Systems architecture based on UNIX as a starting point, ACTC's skills in software migration and conversion put it in the centre of the most active "business" in the industry.❖

ACTC Technologies Inc.
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Calgary, Alberta, T2E 7H7
Phone (403) 295-5900, Fax (403) 295-5999

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- waste management - technology development in waste management including incineration; solidification; fermentation; cellulosic waste utilization
- living natural resources - wildlife productivity; problem wildlife research; aquatic habitat studies; fish studies.

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Dr. Sherman Weaver
Executive Director
Alberta Environmental Centre
P.O. Bag 4000
Vegreville, Alberta, Canada T0B 4L0
Telephone: (403) 632-6761

Austec

Edmonton firm specializes in electronic identification

Firefighters never know when they will encounter dangerous materials. Austec's new system, in development, pinpoints and identifies hazardous materials 300 meters away

Transponders (electronic devices that transmit or respond to radio or microwave signals, used to identify and track objects) have been used to locate and follow the progress of subjects as diverse as ducks, trucks, trains and lanes. The principals of an Edmonton firm, Austec Electronic Systems Ltd., have been in the forefront of the development and application of transponder technology (more accurately defined as "electronic communication and identification systems") for several decades.

Austec Electronic Systems carries out consulting, design, testing and manufacture of electronic systems for manufacturers, government agencies and consultants. Austec also designs industrial electronic equipment, including both hardware and software development, and microwave radio frequency design and testing.

The company's plant is a 10,000-square-foot facility with offices, laboratories and production workshops. Seven professional engineers and four technologists form the technical staff.

Automatic railway car identification and train location systems

Between the years of 1980 and 1986, Keith Brockelsby, P.Eng., Austec's president, and Dr. Conrad Walker, vice-president, were founders and part owners of EID Systems Ltd., a company formed with Canadian National Railways to develop and promote automatic railway car identification systems for the industry. Michael Hyryciuk, P.Eng., joined the team as chief engineer, a position he still holds. During this time, EID Systems developed an advanced form of automated car identification which was implemented for CN's specific purposes. In 1987, CNR became the sole owner of EIDSystems, and Austec was incorporated to allow its principals to continue with the development of related electronic systems and to offer consulting services.

Austec personnel have been participants in the Advanced Train Control System project, creating a system to locate trains, since its beginning. Austec initiated studies of the optimum radio frequencies to be used in such a system, and demonstration equipment was constructed and tested at the American Association of Railroads test facility in Pueblo, New Mexico. Trials proved that indeed the equipment would meet all requirements.

In 1989, Austec was contracted by Vapor Canada to design the new train location transponder and reader equipment, to be offered as part of a complete Advanced Train Control system by a consortium of Canadian companies. The equipmentwas tested and accepted by CNR. Austec completed the project over a period of ten months.

Electronic Identification System for Fishing Vessels

In 1987, Austec won a contract from Supply and Services Canada to develop an engineering concept and prepare specifications for the remote electronic identification of fishing vessels for the Department of Fisheries and Oceans.The department recognized that the effectiveness of their surveillance of both the east and west coast fisheries could be enhanced by the introduction of some form of automatic identification of vessels licensed to fish in allocated areas. "The time spent by patrol aircraft and surface ships in checking the identity of fishing vessels could be drastically reduced if those who were operating illegally could be established from a distance, say ten miles or more,"Mr. Brockelsby explains.

Austec won the first phase of a development contract for a stand-off electronic identification system, and the concept and initial specification, written in accordance with military standards, was accepted by the Department of Fisheries and Oceans. The system design concept was based upon a solution to the problem of distinguishing between several fishing vessels fitted with identification transmitters in close physical proximity to one another. Austec developed a computer simulation model to check the performance of the proposed system; however, work on the project wss suspended in 1989 following federal government budget and policy changes. "The project is likely to be reactivated," says Mr. Brockelsby, "in light of the pressing need for control and surveillance of fisheries around the world."

Automatic Vehicle Identification System

Between September 1988 and October 1989, Austec successfully completed the construction, installation and testing of a prototype automatic vehicle identification system, for the Arizona Department of Transportation as part of the Heavy Vehicle Electronic License Plate (HELP) program. Part of the program involves an automated weigh-scale system for commercial highway transporters. The company's personnel have been heavily involved in the system for several years—as EID Systems in 1986 they supplied automatic vehicle identification equipment for the initial stages. When tested in laboratory, test track and field situations, this equipment showed the greatest performance in terms of accuracy and reliability.

"Our personnel have led the way in suggesting and designing equipment with the features desired by HELP," says Mr. Brockelsby. "In particular, we developed an innovative microwave antenna system installed in the road surface."Patents protecting this system have been issued in several countries.

In January 1990, Austec reached an agreeement with VaporCanada to jointly complete the development of a comprehensive AVI system. "This equipment will have a multi-million-dollar application in vehicle identification markets throughout the world in coming years," Mr. Brockelsby states.

Locating and identifying dangerous goods

Austec's current work includes the investigation of a system for the remote identification of dangerous goods. Mr. Brockelsby explains that it involves the adaptation of existing technologies for the identification of hazardous materials at an accident scene from a safe distance, using short-range radio equipment. "The problem for emergency response personnel at present, is that they don't know what they're walking into at the scene of a fire or an accident,"he says. "While the crew may be aware that they are dealing with a dangerous material, they may not be aware of its exact nature. This system, for which patent protection has been applied, is capable of transmitting coded information up to 300 metres through smoke, fog, rain or snow. A directional antenna enables the user to identify the location of hazardous materials. This technology could be further developed for a variety of hazardous materials monitoring, handling and storage applications."

This system can allow dangerous goods to be identified in a stationary location, such as a storage depot or warehouse, or a moving vehicle such as a truck or train. It is entirely feasible that this system could be combined with other identification systems. In conjunction with the railcar system, for example, or the HELP program, it could be used to track the location of railcars or vehicles carrying hazardous materials. Truckers carrying a transmitter would find it difficult, if not impossible, to flout dangerous goods regulations.

Austec is building on its base of electronic identification technology, modifying and applying it to a broader variety of uses.◆

Rail car location and content indentification - poineered and developed by Austec's principals

Austec Electronic Systems Ltd.
17310 107 - Avenue
Edmonton, Alberta
Phone (403) 486-0511, Fax (403) 489-3697

Austec
ELECTRONIC SYSTEMS LTD.

ED TEL Is Your Direct Line To Advanced Technology.

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For over a century, ED TEL has been on the leading edge of change, from Edmonton's first phone call to the latest fibre optic technologies. Along the way, we've introduced a host of high-tech "firsts," including the first touch tone phone service in the West. The first enhanced 911 (ALIVE) emergency number installation. The first successful ISDN field trials in Canada. And the first Cellular service in Alberta.

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ED TEL is more than Edmonton's single source for advanced telecommunications technologies. We also offer a full range of business products and services across Alberta, Canada and the world through ETCOM International, our wholly-owned subsidiary. Together, we offer every conceivable telecommunications product and service—from business phone systems and faxes, to computers, and interactive network and communication consulting services. In short, high tech isn't just a high priority. At ED TEL, it's a way of life. For more information on ETCOM International, contact Mr. Laith Zalzalah at 403-441-7422. ETCOM

Network Solutions For The Nineties.

ED TEL is at the forefront of the movement to convert digital fibre optic technologies. One example is our use of fibre optic technology to transmit Oilers hockey telecasts across Canada. In fact, we can now provide digital network services anywhere in our service area—something few other companies in the world can claim. ED TEL network solutions make it possible to combine voice, data and video transmissions, opening a world of opportunities to our business customers. For more information on ED TEL products and services, please call (403) 447-BEST (403-447-2378) or write ED TEL, Mr. Jack Laurie, Sales Department, Box 20500, Edmonton, Alberta T5J 2R4.

Edmonton Telephones Corporation

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Chembiomed Ltd.

An Alberta-based company making major innovative contributions to health

Synsorb: used in the manufacture of blood derived products

Chembiomed's state-of-the-art R&D facility located in the Edmonton Research Park

Biotechnology has seen the introduction of new theraputic products stemming from DNA- and protein-based chemistries. Carbohydrate technology is rapidly emerging as the next major source of innovative products for medical applications. Chembiomed Ltd., an Edmonton based biotechnology company, is recognized as a world leader in the application of this technology for theraputic uses.

Chembiomed was founded by the University of Alberta to commericalize the technology developed by Dr. Raymond Lemieux, a world-renowned carbohydrate chemist. Dr. Lemieux's pioneering work focused on the chemical synthesis of the carbohydrates of the blood system. It was this technology which Chembiomed employed for the development and commercialization of its first products.

Although Chembiomed is a relatively small company, it has attained a number of impressive achievements in the field of biotechnology. The company obtained four of the first five licenses issued by the American Food and Drug Administration (FDA) for the manufacture and sales, in the United States, of monoclonal antibody blood typing reagents (SYNTYPE™). The SYNTYPE product line includes reagents for the typing of A, B, Lewis A and Lewis B blood types. More than 90% of these products, which are manufactured in Edmonton, are sold to export markets. Chembiomed was also the first company to receive approval from the Japanese Ministry of Health for the sale of these products in Japan.

The company was also the first in Canada to receive an Orphan Drug Designation from the FDA for theraputic applications. This designation gives a company exclusive rights to market a product in the U.S for a period of seven years after approval is granted.

Present Carbohydrate Technology

Chembiomed also manufactures a unique product called SYNSORB™. SYNSORB is used by manufacturers of blood-derived theraputic products, such as Factor VIII, to remove specific unwanted contaminants. This product, like SYNTYPE, enjoys significant export markets.

Chembiomed has also designed an exciting product for use in transplantation of incompatible bone marrow and kidneys. The product, BIOSYNSORB™, selectively removes ABO blood group-specific anitbodies from the blood. These antibodies can be responsible for the rejection of donated marrow or kidneys when the recipient's and donor's blood groups do not match. The removal of these antibodies is performed by passing a transplant candidate's blood through a small cartridge. The blood returned to the patient is depleted of ABO antibodies. This permits the transplantation of an incompatible kidney or bone marrow. BIOSYNSORB is currently undergoing clinical trials in a multi-centre investigation. Once the clinical trials are completed, Chembiomed expects to receive approval to market the product in late 1992 or early 1993.

Future Carbohydrate Applications

Chembiomed has long recognized that enduring success in the biotechnology industry requires the regular introduction of products. To achieve this, the company has adopted a research and development program to create products for the treatment of major medical problems. Chembiomed has indentified areas that are amenable to solutions based on carbohydrate technology. These include:

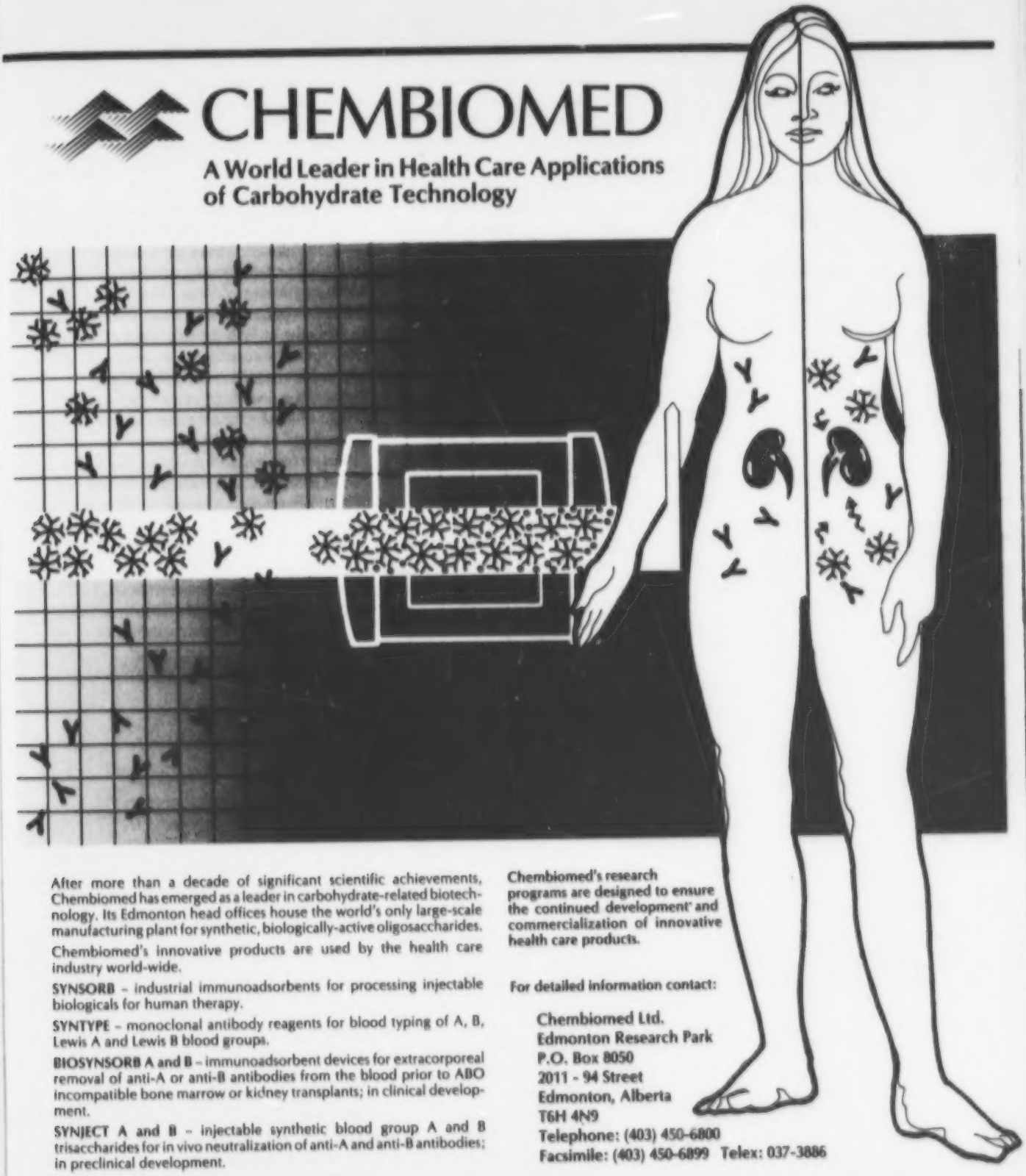
- carbohydrate-containing polymer materials, expected to function as vascular prostheses or implants of superior biocompatibility
- analogs of tumor-associated oligosaccharides, which will act as immunotheraputic agents or vaccine antigens against cancer
- novel carbohydrate-derived glycoproteins, expected to act as antigen carriers for more effective vaccinations
- oligosaccharide analogs, for the inhibition of glycoprotein assembly which may be effective in the treatment of AIDS

By identifying these promising areas for carbohydrate based products, Chembiomed's previous successes will continue.♦

CHEMBIOMED LTD.

CHEMBIOMED

A World Leader in Health Care Applications of Carbohydrate Technology



After more than a decade of significant scientific achievements, Chembiomed has emerged as a leader in carbohydrate-related biotechnology. Its Edmonton head offices house the world's only large-scale manufacturing plant for synthetic, biologically-active oligosaccharides.

Chembiomed's innovative products are used by the health care industry world-wide.

SYNSORB – industrial immunoadsorbents for processing injectable biologicals for human therapy.

SYNTYPE – monoclonal antibody reagents for blood typing of A, B, Lewis A and Lewis B blood groups.

BIOSYNSORB A and B – immunoadsorbent devices for extracorporeal removal of anti-A or anti-B antibodies from the blood prior to ABO incompatible bone marrow or kidney transplants; in clinical development.

SYNJECT A and B – injectable synthetic blood group A and B trisaccharides for in vivo neutralization of anti-A and anti-B antibodies; in preclinical development.

Chembiomed's research programs are designed to ensure the continued development and commercialization of innovative health care products.

For detailed information contact:

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Telephone: (403) 450-6800
Facsimile: (403) 450-6899 Telex: 037-3886

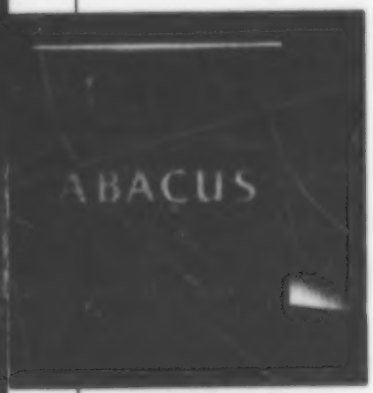
Comsoft

Aiming at World Markets with ABACUS Accounting Software

Comsoft Inc., an Edmonton software company, has developed an accounting program that has accountants smiling. It's no laughing matter for the competition, however.

The company has tripled in size over the past six months, and sets its sights on the world marketplace with its easy to use accounting software packages: Abacus® Basic, Abacus® I, and Abacus® II Software. "This package is so flexible, we can take manual bookkeepers through an intensive training course, have them computer literate on Abacus® II within a few days, and pulling corporate financial statements within a month," says Dwayne Kushniruk, Comsoft's vice-president, marketing.

"In a manner of speaking, its success has overwhelmed us," he adds. "We've reorganized the company, expanded, and fine-tuned our marketing program. We're a year ahead of where we thought we'd be."



ABACUS II: a multi-user program with industry-specific solutions

A recent promotion, costing over $100,000, saw 50,000 packages containing brochures and a demonstration disk of the Abacus® programs distributed to chartered accountants across Canada."We were concerned about our timing. We sent it to accountants at their busiest season — income tax time," says Mr. Kushniruk. "But the promotion nearly paid for itself within three weeks."

Comsoft started during the downturn in the Alberta economy in 1983. "I was in aviation then," Mr. Kushniruk explains, "and I realized the need to improve efficiency. I hired Terry Orletsky to develop industry-specific software to streamline my business. We then decided to form a company, and set out to develop a generic accounting system which could be used by any small- to medium-sized business. Mr. Orletsky is regarded as a programming pioneer. Among his credits are writing the firstcomputerized typesetting system for the Xerox 9700 laser printer and the code for the first microcomputer debug program.

Comsoft was unique right from the start because of its philosophy of progressive software design. It was also a small Edmonton-based firm, going nose-to-nose against the industry giants such as IBM, Xerox and Prentice-Hall.

"Our first business plan identified 15 major competitors," says Mr. Kushniruk. "We knew we had to take a different approach." While major companies have huge sums of money to invest in research and development, Comsoft had limited operating capital. The software package was developed by working in conjunction with end-users. "This," Mr. Kushniruk says confidently, "has resulted in the best software package available."

Program design was based on end-user needs and requests, with uncompromising attention paid to flexibility and ease of use, even for beginners. Initial testing was done in-house, where programmers did everything they could to defeat the system until they were satisified it met all their criteria. In the final development stage, prototype software was used by selected companies who tried to find flaws. Their findings, questions and concerns were reported to Comsoft, where the necessary changes were implemented to make the program as complete and easy to use as possible.

In 1985, Abacus® I was launched into the market. It is a horizontal integrated accounting program for use with IBM and IBM-compatible PC's. "By a horizontal program, we mean a system which has built-in flexibility to allow it to be used by most companies without customization." explains Mr. Kushniruk. "Most of the accounting packages available are

***ABACUS:** a horizontal integrated accounting program*

modular packages, which require cumbersome and complex inter-module data transfer."

Abacus® II was developed for multi-user applications. In addition to all of the normal accounting functions required by most businesses, it handles industry-specific solutions, including job estimating and costing, and inventory/order entry. Abacus® II provides "real time" financial information, while allowing comparisons to be made with past years and budget figures.

"Our policy is that whatever you can do with pencil and paper, you should be able to do with a computer. Wherever possible, entry screens emulate familiar bookkeeping forms: an invoice *looks* like an invoice, and so on," Mr. Kushniruk states.

By the end of 1989, a network of 85 dealers had been established from Halifax to Victoria to sell, service and train users of Abacus® accounting systems. After 16 Canadian trade shows, Comsoft took a tentative step into the U.S market by attending COMDEX, Las Vegas, the largest computer trade show in North America.

"Being one of 1,700 exhibitors, with 120,000 people viewing that show over a five-day period was a little daunting," admits Mr. Kushniruk. "It felt like David and Goliath!"

"But people kept coming by, and they were amazed at the program. When our competition reacted, we knew we were really on to something."

"Some wanted to order packages. Others wanted to be dealers. We weren't quite ready for the U.S, market — U.S. payroll was still in development — so we had to put them on hold. We knew that our technology was clearly ahead of the pack, but that we'd have to move fast to stay ahead," he adds.

It's been the high road for Comsoft since. The programming staff has tripled, and sales offices have been established in Toronto, Vancouver and Victoria. A U.S. office opens in San Diego this fall.

"We're projecting 500 North American dealers by the end of 1990. As a result of the COMDEX show, negotiations with various international connections are underway. European companies are enquiring about licensing agreements."

Comsoft has just sold a license for its software packages to a large computer manufacturer in South Korea; Comsoft will supply the programming and programming tools to the Koreans, who will then translate it into their language. Comsoft retains all patents and copyrights on the programming.

Comsoft offers five packages in the product family: Abacus® Basic, a general accounting system and bookkeeping tutorial; Abacus® I, an integrated single-user accounting system; Abacus® II, a multi-user accounting system; Abacus® Canadian Payroll System; and dB Detective and MicroScribe, a high-speed search and retrieval system and text editor. dB Detective is the fastest non-indexed database record retrieval program in existence, according to Mr. Kushniruk, capable of searching 300 to 1,000 records per second.

"Our customer support is as unique as our product," Mr. Kushniruk says. "Each customer may subscribe to our updates, which are issued twice a year at a cost of $95 each. This price includes unlimited telephone support." Abacus® updates will include an easy to use GST package.

Comsoft also offers customers a unique way to move up through the Abacus® family of products: if a company has purchased Abacus® Basic or Abacus® I and later decides to upgrade to Abacus® II, they may purchase the upgraded package simply for the difference in price between the two, and run a conversion program to transfer existing data to the new system.

Comsoft also gives a 30-day money-back guarantee — if a purchaser is not satisfied with the program, it can be returned to Comsoft for a full refund.

Customer and dealer inquiries are welcome. In fact, a demonstration disk is *free* for the asking. ◆

ABACUS on display - at COMDEX, response was overwhelming

Comsoft Inc.
208, 10335 172 Street,
P.O. Box 3835, Postal Station D,
Edmonton, Alberta T5S 1K9
Phone (403)489-5994, Fax (403)486-4335

COMSOFT INC.

Prairie Biological Research Ltd.

The leading edge in toxic substance testing

Technician Sivan Nair uses the colony counter

Dr. Frank Kozar at the microscope

In a quiet industrial mall on Edmonton's south side, a discreet sign announces the location of PBR—Prairie Biological Research Ltd.

From the outside, it looks like any other commercial business. But inside the doors of this compact but well-equipped laboratory, a full range of toxic substance testing and monitoring takes place. In one corner, water samples are being tested for the presence of toxic, mutagenic and carcinogenic substances. In another section, test tubes incubate potentially hazardous bacteria and fungi from air samples. Another area tests human blood samples, exfoliated cells (usually saliva) and urine samples for damage from exposure to industrial chemicals or radiation.

Dr. Ram Mehta, a genetic toxicologist, is the president and research manager of Prairie Biological Research, which he founded in 1984. "We use approximately 60,000 natural and synthetic chemicals in our daily lives. An estimated 1,200 new chemical compounds are created every year. We also know that 70% to 80% of human cancers are caused by chemicals. Now, many of these chemicals are what we call mutagens, that is, they are able to interact with DNA—our genes, and are responsible for causing hereditary disorders and cancer in humans. We screen pure chemicals, industrial effluents and other environmental samples for the presence of mutagens and carcinogens, using a variety of procedures, some of which we have developed ourselves," explains Dr. Mehta.

In addition, PBR monitors and tests air samples for the presence of chemicals, bacteria and fungi. "We have portable and static air monitoring equipment, which can check for the presence of specific gases or chemicals in the air; carbon monoxide or formaldehyde, for example. We also can take microbiological samples to check for the presence of airborne microbes. We have done this work for hospitals and nursing homes," Dr. Mehta continues. PBR also tests for microbial and chemical contaminants in food, beverages, and consumer products; monitors the microbiological quality of recreational and drinking water, and checks biological oxygen demand of process streams and industrial effluents.

Working with Dr. Frank Kozar, executive director, and Dr. Siew-Keen Quah, research scientist, Dr. Mehta has committed PBR to a program of research and development, and education programs. Research and development focuses on the application of biosensors, DNA probes, rapid toxicity tests and microbial assays to detect contaminants. Additionally, PBR is involved in the use and development of microbial strains for bioremediation of industrial effluents. Genetic and cellular toxicology tests offered by PBR are applied by pharmaceutical and chemical industries, and medical device manufacturers to evaluate their products for safety and efficacy, and to prepare material safety data sheets (MSDS).

PBR offers consulting, workshops and seminars to a wide range of businesses. Some of these areas include biosafety (safe practices and procedures in the handling of known and potentially hazardous organisms and biological materials); chemical safety; compliance (good laboratory practices and environmental protection and worker safety regulations); quality control for biology, toxicology and biotechnology laboratories; and risk assessment of chemical exposure and biotechnology applications.

"Much of the technology which we employ in our testing procedures is relatively new," says Dr. Mehta, "and we are one of only two laboratories in Canada that offer this range of services. There are, to my knowledge, 33 companies in the United States which offer similar testing facilities, yet we charge approximately 30% less than the costs of similar tests in American labs."◆

Prairie Biological Services
4290 - 91A Street, Block C
Edmonton, Alberta, T6E 5V2
Phone (403) 450-3957
Fax (403) 450-3960

Focus Seismic Corporation

The focus for petroleum exploration

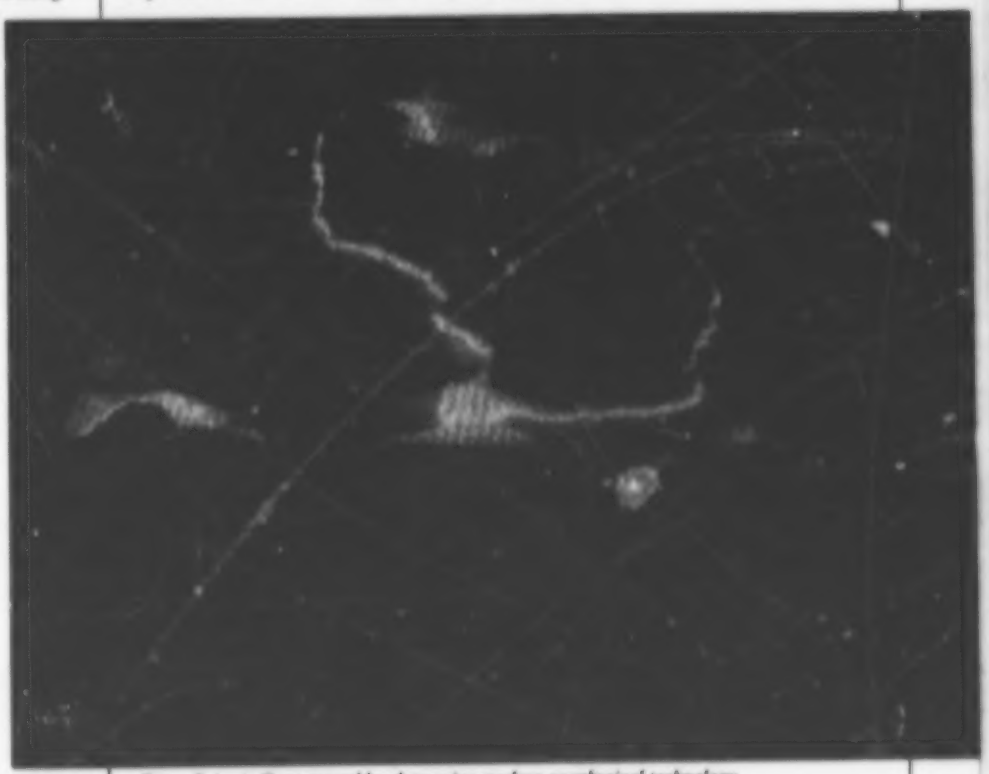
Calgary's Focus Seismic Corp. designs, conducts and markets seismic surveys to the petroleum exploration industry. "We create and distribute seismic data, providing an invaluable aid in the exploration process," explains the company's founder, Bogdan Ulaszonek. "When Focus was established in 1987, it started from scratch without a database. In three years, thanks to the effective marketing, the inventory stands at 1870 kilometres of two-dimensional data, and 28 square kilometres of three-dimensional data."

Focus Seismic Corporation establishes a prospective project area by carefully analyzing several key exploration factors. Concentrating on the hydrocarbon targets the industry is hotly pursuing, in areas where good drilling rights are available, makes a program attractive. Terrain conditions influence the operating season and the type of equipment which must be deployed. Agriculture, wildlife, and environmental concerns must all be addressed through effective channels of communication throughout all phases of the program: design, operation, and even the post-survey phase.

During the program design stage, Focus researches professional opinion throughout the petroleum industry to ensure a satisfied clientele. New recording techniques and the latest software and technological developments are blended together to acquire first-class data. Deeper geologic targets and complex stratigraphic displays, which were difficult to detect with former seismic methods, are becoming easier to delineate through the application of modern geophysical technology. The advantage of new data, coupled with the fact that many oil companies are ceasing to sell their proprietary data, enables Focus to provide a necessary service.

Relatively inexpensive seismic data is made possible through multi-party participation. When Focus Seismic Corp. targets an area, it approaches a number of corporations or consultants who may be interested in subscribing to the information. All parties participate in the strictest confidence.

"We believe that the participation approach to seismic data acquisition, which is extremely cost-effective, benefits not only the domestic market, but foreign companies looking for international reserves, and governments selling drilling rights to large exploration tracts," Mr. Ulaszonek concludes.◆



Focus Seismic Corp assembles data using modern geophysical technology.

Focus Seismic Corporation
1520, 840 - 7th Avenue S.W.,
Calgary, Alberta, T2P 3G4
Phone (403) 294-1020,
Fax (403) 265-9249

FOCUS
SEISMIC CORP.

Alberta High Te

		Telecomm	Comp/Software	Advanced Industries	Bio/Pharm/Chem	Environmental/OH	Electronics	Medical Devices	Adv. Mats./Engineer	
Alberta Technology, Research & Telecomunications	Ph: 422-0567 Fax: 420-1474		●							Tony Myers
A. Comeau and Associates ltd.	465-9961 465-4990		●							Neil McNeil
A.C.T. Computer Services Ltd.	451-5555 452-0756		●							Ray Johnson
A.D. Williams Engineering Ltd.	424-2393 425-1520					●				Allen Williams
A.V. Energy Inc.	228-2855 228-2951					●				William Vanderleg
Aaron Control	291-3241 291-2577						●			Peter Brown
Absolute F/X Inc.	486-3761 489-2286								●	Misha Shifrin
Accelerated Software	456-9163		●							Dr. Vernie Yee
Accountability computer Services	233-7575		●							Paul Ericson
Accurcom Engineering Ltd.	271-0733	●								Fred Morris
Ace Drilling Mud Inc.	229-3020 229-0813					●				D. W. Smith
Acorn Systems	800-963-6185		●							John Young
ACT Medical Systems, Div. of XI (Canada) Ltd.	661-5668 261-4688		●							Steve Fulkerson
ACTC Technologies Inc.	239-5585 295-5999		●							Ronald E. George
Adita Enterprises Ind.	274-7494	●								Myron Achtman
AFS International Inc.	262-1833 237-7441					●				Gerry Klopp
AGAT Labatatories Ltd.	291-2428 250-5295								●	John Desanti

ech Companies

		Telecomm	Comp/Software	Advanced Industries	Bio/Pharm/Chem	Environmental/Oil	Electronics	Medical Devices	Adv. Mats./Engineer	
Agricomp Services	Ph: 295-2605 Fax: 295-0386		●							Keith Jones
AGT (Alberta Government Telephones)	493-5000	●								Bruce Miller
Airborne Precision Instruments Ltd.	275-4211 275-8425								●	Niel M. Birch
AIS - Alternative Information System	234-0188 264-3067	●								Jamie Lindenbock
Alberta Centre for Machine Intelligence	492-5353 492-1438	●	●		●		●		●	Boyd Wark
Alberta Compressor Valve Co. Ltd.	461-7288 461-6049			●						Boyd Wark
Alberta Computer Cable Inc.	291-5560 291-1112		●							Bob Kirby
Alberta Environmental Centre	632-6761 632-5492		●		●	●			●	Dr. Sherman Weaver
Alberta Heritage Foundation for Medical Research	423-5727 429-3509				●					Lois Hammond
Alberta Laser Applications Science and Engineering	436-9750 437-1240						●			
Alberta Microelectronics Center	492-3194 492-1643						●			John Zupanic
Alberta Oil Sands Technology and Research	427-7623 422-9112			●						Jackie Alton See page A7
Alberta Poly Tubes Ltd.	452-8376 452-8397								●	Jim McCaffery
Alberta Printed Circuits Ltd.	250-3406 291-2428						●			Wayne Bamber
Alberta Research Council	450-5111 450-5198	●	●	●	●	●	●	●	●	Dr. Duncan J. Currie See page A25-26
Alberta Special Waste Management Corp.	422-5029 428-9627					●				Ken Simpson
Alberta Special Waste Mng. & Chem Securities	250-3742 250-3909					●				Rod Leland

		Telecomm	Comp./Software	Advanced Industries	Bio/Pharm./Chem	Environment/Oil	Electronics	Medical Devices	Adv. Mat./Engineer	
Alberta Telecommunications Research Centre	Ph: 461-3830 Fax: 463-3010	●								Ray Fortune
Alchem, Inc.	468-0090 468-4308			●						Bill Rodgers
Allied Seismic	247-2167					●				Craig Maxwell
Allied Wire & Cable Ltd.	243-4980 287-3239						●			Marti Postrok
Alltemp Sensors, Inc.	463-7035 462-0017								●	Paul Poechman
Alpha Tech Tron Systems Ltd.	328-2230 328-2636						●			Mike Miskulin
Alphanet Systems Inc.	434-2957						●			John Zukiwsky
Alphatel Computer Products	452-0025 455-4060		●							Robert Abell
Alphatel Systems	451-5761	●	●							Dr. Robert Abell
Alta - Telecomm. International	530-5656 530-5687	●								Graham Pollock
Alta Genetics Inc.	239-8882 239-8886				●					Doug Blair
Altank Industries Ltd.	279-2926 279-6788								●	Roy Reed
Alvins Oilfiel Supply Co. Ltd.	236-9653 236-9655					●				Digby Graham
Amador Ltd.	483-2727 489-2601		●							R.L. Bond
AMH Resource Management Ltd.	262-5250 233-7185		●							Allan Ashton
Amoco Canada Petroleum Co. Ltd.	233-1313 233-6272					●				Don Stacy
Ankha Nuclear Industries (Canada) Inc.	250-3645 262-7597	●								Dr. J. W. Greidanus
Apex Metal Industries Ltd.	236-0669 236-9337								●	Roger E. Frei
Applied Engineering Science Group	248-1100 273-6159		●						●	Alf Hunka
Applied Materials Technology Ltd.	434-9598 436-4077								●	Wally Kuchar

		Telecomm	Comp/Software	Advanced Industries	Bio/Pharm/Chem	Environment/Oil	Electronics	Medical Devices	Adv. Mats./Engineer	
Applied Terravisions Systems Ltd.	Ph: 266-9595 Fax: 262-1855		●		●	●				R.W. Trotiak
Arcturus Software	281-1632		●							John McNamee
ASAP Software Ltd.	262-2702 264-3629		●							Carrie Matcalf
Ashton Electronics Inc. Ltd.	236-7988					●				John Johnston
Aspen Computing Solutions Ltd.	287-3466 243-3734		●							Collin Marx
Associated Respiratory Services Inc.	453-6166 452-4995		●				●	●		Terry Zimmerman
ATC Medical & Consultants	262-6570 261-4688		●							Philip Oldale
Athabasca Research Corp. Ltd.	489-4444 484-6414	●	●					●	●	Thomas E. Adams
Aurora Bar Code Technologies	483-6025 484-8767								●	Ian Bowden
Austec Electronic Systems	486-0511 489-3697		●			●			●	Keith Brockelsby
Auto Administrator Western Inc.	291-9871		●							Rick Hernder
Auto-Trol Technology (Can.) Ltd.	250-1232 250-1037		●							Ken Dedeluk
Axelson Industries (1984) Ltd.	465-9242 469-2070					●				Ms. Myra Mack
B & B Computer Applications Ltd.	237-6835		●							Gary Biagioni
B & J Titan Services Ltd.	266-6234 237-8929					●				Wayne McKlaren
B & W Technologies	248-9226 273-3708					●	●			Cody Slater
Baker Electronic Enterprises Inc.	465-0107 465-0130						●			Peter VanDerZee
Baker Oil Treating Ltd.	279-8959 236-8766			●					●	Barry McMillan
Banks - Isaak Systems Ltd.	454-0210 452-0756		●							J. P. Banks
Barber Engineering Controls Ltd.	252-7651 252-7799								●	Eric Connelley

		Telecomm	Comp/Software	Advanced Industries	Bio/Pharm/Chem	Environment/Oil	Electronics	Medical Devices	Adv. Mat./Engineer	
Barber Industries Ltd.	Ph: 279-7511 Fax: 279-4136								●	Reg Worsley
Barnett Engineering Ltd.	255-9544 259-2343						●			Mr. Brian Barnett
Bartronics (1972) Ltd.	455-6032 452-4530	●	●	●			●			Raymond Barnes
Behrens Data Consulting Ltd.	269-9292 266-1288		●							Ronald Springer
Bellmont Electrical Ind. Ltd.	273-3155 273-1073						●			Mr. E. R. Nociar
Bellmont Electrical Industries Ltd.	273-3155 273-1073						●			E.R. Nociar
Bercha International Inc.	270-2221 270-2014	●								Frank Bercha
Bertonee Inc.	569-1500 235-3339					●	●		●	Tom Lambourne
Beta Cor Engineering, Ltd.	482-1561		●						●	Morgan Barnes
Beta Machinery Analysis Ltd.	245-5666 245-3257								●	Thomas Klien
Beta Monitors & controls Ltd.	245-5300 245-3257						●			Russ Wood
Beta Research Laboratories Ltd.	291-0362 250-9212				●					Bruce Freeman
Betz, Inc.	468-7604 469-5190								●	John Town
Bio Technica Canada Inc.	295-0383 295-0386				●	●				Murray Ruhr
Bio-Chem Consulting Services Ltd.	250-7418 291-5681				●					Roger Giovanetto
Biomech Design	492-1619 492-1617				●	●	●	●	●	Kelvin James
Biomedical Engineering Service & Support Inc.	450-2059 484-1025		●					●		Pat Fair
Biomira Inc.	450-3761 463-0871				●			●		Gordon Politeski
Biotechnica Canada Inc.	295-0383 295-0386				●					Murry Ruhi
Biotex Laboratories	455-6079 451-2063				●					Jackie Wells

		Telecomm	Comp/Software	Advanced Industries	Bio/Pharm/Chem	Environment/Oil	Electronics	Medical Devices	Adv. Mat./Engineer	
Bissett Resource Consultant Ltd.	Ph: 294-1888 Fax: 263-0073				●					Mr. K R. Bissett
Bluebird Electronic Publishers	430-8245		●							Russel Sawchuk
BMP Energy Systems Group Design	234-7979 262-9775				●					Gerald Feschuk
Borden Chemical Ltd.	269-3596			●						Linda Nykiforuk
Bow Valley Industries	261-6100 261-6105				●					Daryl Seaman
Boyd Exploration Consultants Ltd.	233-2455 265-2042				●					John Boyd
Bralorne Resources Ltd.	268-0700 263-6864				●					Mr. William Limin
Brand Computer Software Ltd.	482-3683		●							Dodie Brand
Brant Computer Services	424-2111 424-2515		●							Bruce Lions
Bromley Mechanical Services (1985) Ltd.	526-3142 526-1061								●	Dexter Murschell
BSL Machine Ltd.	462-6520 450-9701								●	Joe Blatter
BTU Panels	464-9692 416- 464-6070								●	
Calcomp Canada Inc.	250-5555 633-5103		●							Frank Roy
Calgary Controls Ltd.	253-6101 259-2078	●								Cal Manz
Calgary Economics Development Board	268-2771 268-1946									Bruce McDonald
Calgary Research & Development Authority	282-0464 282-1238									Bill Croft
Camrose Electric Controls Ltd.	435-5195 434-7887								●	Ken Hillman
Canadian Advanced Technology Asssociation	250-2560 250-1964		●							Robert Blackshaw
Canadian Chemical Producers' Association	420-1144 425-4623			●						Frank Markson
Canadian Energy Developments, Inc.	462-8021 450-1016								●	Dr. Fritz Boehm

		Telecomm	Comp/Software	Advanced Industries	Bio/Pharm/Chem	Environment/Oil	Electronics	Medical Devices	Adv. Mats./Engineer	
Canadian Energy Research Institute	Ph: 282-1231 Fax: 284-4181									Gerry Angevine
Canadian Erectors Ltd.	279-8310 279-0120								●	Stewart Kirby
Canadian Foremost Ltd.	248-3322 235-2186								●	Jack Nodwell
Canadian Fracmaster Ltd.	262-2222 265-4967					●				Ron Bowan
Canadian Occidental Petroleum Ltd.	234-6700 263-8673					●				John McKay
Canadian Oilfield Stimulation Services Ltd.	227-5858 227-2560				●	●	●		●	Tom Whiting
Canadian Rig Ltd.	287-1910 287-2367					●				John Gilbank
Canadian Rig Manufacturers Ltd.	287-1910 287-2367								●	John Gilbank
Canadian Standards Assoc.	450-2111 461-5322									Harold Knudsen
Canadian Strategic Services Ltd.	284-1112					●				Roy Nishizoki
Canadian Transworld Limited	461-0249 461-0323						●		●	Malcolm Gibbons
Canalta Data Services	236-6300 279-7033		●							Steve Vanderleest
Cancarb, Ltd.	527-1121 529-6093			●						Ron Schwentafsky
Candella Systems Ltd.	423-2619 424-9464		●							Garth Grainger
Cantech Corporation	250-9888 291-5659					●				Paul Talbot
Canterra Electronics	486-3130 489-7670						●			Bruno Dobler
Canterra Engineering Ltd.	295-7676 295-7683								●	Preston Maddin
Cantex Producing Ltd.	269-2825 233-2055					●				Dave Walker
Canutel Industries Ltd.	782-4838 782-4949	●		●		●	●			Hugo Wagmuller
Carbomedics Canada Ltd.	295-8565 295-0473							●		Tery Marlett

		Telecomm	Comp/Software	Advanced Industries	Bio/Pharm/Chem	Environment/Oil	Electronics	Medical Devices	Adv. Mat./Engineer	
Carl Zeiss Canada Ltd.	800- 663-0958 604- 520-6695						●			Dr. Blennemar
Carlew, Inc	Ph: 279-8552 Fax: 279-6696		●						●	Robert Teau
Catalyst Recovery, Canada, Ltd.	527-4400 526-2465			●						Stan Zezik
Cavalier Bumper Service & Calgary Platin	287-0910 243-4087			●					●	Dwight Murray
CBTS Computer Based Training Systems Ltd.	275-1680 295-2045		●							Alex Stephens
Coda Reactor Ltd.	253-3233 252-6700				●					Ernie Koop
CEL Software	429-1799 426-4766		●	●						Bruce Matichuk, Chris Matichuk
Celanese Canada, Inc	471-0511 471-3246			●						Dr. Brownly
Century Machine Company Ltd.	250-9742 250-8624								●	Peter Hutton
Ceramic Technologies Inc.	450-5600 428-5376								●	Charles Bournat
Cessco Fabrication and Engineering, Ltd.	433-9531 432-7899								●	C. T. Muirhead
CFM Air Equipment	252-1177 252-1275			●						Bill Rutherford
CGG Geophysical Canada Ltd.	266-1011 291-9430				●					Larry Compon
Champion Northwestern Chemicals Ltd.	234-7881 264-3018					●				John Krokush
Champion Petrochemicals	287-2400					●				Ed Koskey
Chart Information Systems Ltd.	347-3733 347-3150		●							Reg Warkentin
Chembiomed	450-6800 450-6899					●				David Rafter See page A41- A42
Chemex Labs Alberta Inc.	291-3077 291-9468				●					John Stanly
Cherco Compressors Ltd.	236-5252 236-4261								●	Ted Myles
Chimo Polyurethanes Ltd.	264-2245 264-8848								●	Robert Logan

		Telecomm	Comp/Software	Advanced Industries	Bio/Pharm/Chem	Environment/Oil	Electronics	Medical Devices	Adv. Mats./Engineer	
Chinam Assoc. Canada Ltd.	Ph: 251-2355 Fax:									John Chu
Chirrom Equipment Ltd.	250-9444 250-5872								●	Keith Robson
CIFE Canadian Institute of Formantion Eva	294-1360 294-1371					●				Steve Misner
CIOL Projects Ltd	259-3947 259-8425					●				Wayne Danforth
Cipher Systems Ltd.	252-7569 258-2561		●							Brian McNeil
Circa Telecommunications Inc.	258-2011 255-2595	●								Ivan Smith
Cis Can Sales (Western) Ltd.	466-3178 468-5904								●	Alan Kirby
Clinicare Corp.	291-3949 250-8950		●							Denis Niedergal
CMS Corporate Management Systems Ltd.	280-4869 265-8522		●							Mr. Lawrence Lazaruk
Coles Gilbert Association Ltd.	266-9500 262-1855					●				Fred Coles
Colman Organ & Co.	482-5751 488-7069		●							Bill Colman
Colt Engineering Corp	258-8000 252-2291						●			John Read
Comgen Software Service Ltd.	252-6160 258-2807		●							Bryon Hollens
Cominco Fertilizer Calgary Nitrogen Operation	258-4600 258-4692				●					John Anderson
Commonwealth Geophysical Development Co.	246-9190 242-9670				●					Sudhir Jain
Commtronics Communications Ltd.	250-9260 291-9237	●								Doug Michetti
Comptronic Devices ltd.	450-3729 461-9551						●			Dave Siever
Compu-Draft Services Ltd.	228-3538									Maurice Sunderland
Compudoc Systems Ltd.	255-1081 255-6037		●							Allan Simon
Computalog Gearhurt Ltd.	265-6060 237-8493					●				Walter Dawson

		Telecomm	Comp/Software	Advanced Industries	Bio/Pharm/Chem	Environmental/Oil	Electronics	Medical Devices	Adv. Man./Engineer	
Computdata Systems Consulting Inc.	Ph: 258-1448 Fax: 258-1850		●							Cathy Kletke
Computer Environment Solutions	250-5672 250-1138		●							Steve Gibson
Computer Modelling Group	282-9286 282-6459		●							Frank Meyer
Computer Environment Solutions	250-5672 250-1138					●				Steve Gibson
Computer Shop of Calgary Ltd.	243-5005 243-2684		●							Austin Hook
Computer Tech Consultants	233-7233 233-7343		●							Paul Woodhouse
Computerex Centres Ltd./Optical System	263-1190 237-7074		●							Mr. G.M. Kernahan
Computouch Ltd.	233-8558 262-6071		●							Alan Chapman
Computrex Centres Ltd.	263-1190 237-7049		●							Martin Kernahan
Computronix Holdings Ltd.	424-1617 424-2515		●							H. Levsink
Comsoft Inc.	489-5994 486-4335		●							Dwayne Kushniruk See page A43-A44
Concord Scientific Corporation	264-2140 237-7634				●					Don Dabbs
Continental Laboratories Ltd.	250-5125 291-9556			●						James Penington
Core Laboratories	250-4000 250-5120				●					Olev Carbinksi
Corex Dataline Ltd.	489-7915		●							Paul McGee
CR Electronics Ltd.	280-1912 280-1963						●			C.D. Russel
CUL Chemical Laboratory Supplies	291-3504			●						Dr. R. Boynton
Custom Cables Ltd.	262-9666 265-7323		●							Randy Greig
Customs Environment Services Ltd.	440-1825 440-2428				●					Larry Loven
Cybersoft	437-2798 426-4766	●	●							Chris Matichuk

		Telecomm	Comp/Software	Advanced Industries	Bio/Pharm/Chem	Environment/Oil	Electronics	Medical Devices	Adv. Mat./Engineer	
Cytronic Technologies Inc.	Ph: 450-3636 Fax: 462-4858						●			Michael Beauchamp
D & S Petroleum Consulting Group	268-6500 269-7265					●				Tev Den Hartog
D & S Petroleum Consulting Group Ltd.	268-6500 269-7265					●				Ted Denhartog
D. Atkinson & Associates Ltd.	291-2182		●							Dean Atkinson
D.G.L. Software Services Ltd.	234-9202 265-3528		●							D.G. Lundeen
D.I. Associates Inc.	261-5804 261-3770		●							Andrew Hay
Dalcor Data Services Ltd.	424-7296 423-4796		●							John MacDougall
Danen Computer Consulting	477-9545		●							Gerry Danen
Daniel Computing Systems Inc.	264-5937 263-1179		●							Don Mackie
Daniel Industries	279-1879 236-1337						●			Jerry Davis
Data-Man Ltd.	266-4633 265-8522		●							Clyde Pringle
Dataspan Technology Ltd.	237-9313 263-4403		●							Ben Berg
DB Engineered Hydraulics Ltd.	343-3211 346-4730						●			Don Bais
DB Engineers & Construction	252-0987 253-3159								●	Mel Owen
Deep Shaft Technology Inc.	244-5340 245-5156					●				Victor Redekop
Delta Projects Ltd.	258-6411 255-1421					●			●	A.B. Leady
Deltronics Engineering Ltd.	236-5444 236-1707		●							R. Stocco
Det Norske Veritas Canada Ltd.	253-3422 259-3452								●	John German
Devry Institute of Technology	235-5400 273-3554									John Ballhein
Diamant Boart Stratabit Ltd.	263-8025 262-4346					●				Cam Hamilton

		Telecomm	Comp/Software	Advanced Industries	Bio/Pharm/Chem	Environment/Oil	Electronics	Medical Devices	Adv. Mat./Engineer	
Didgitech Information Services Ltd.	Ph: 266-8622 Fax: 233-2917	●								Stephen Kenny
DMR Group Inc.	423-2070 423-0102		●							Bill Clark
DNA Computer Group Inc.	253-9442 255-5597		●							Gil Freund
Dominion Bridge	235-5800 248-6729								●	Ervine Brewer
Dornian Consultants Ltd.	264-5376								●	Nick Dornian
Dow Chemicals Canada Inc.	998-8000 998-8350			●						
Dresser Rand Canada, Inc.	329-3514 329-6077								●	Don Lane
Drill Systems International Ltd.	248-3322 235-2186								●	Maurie Marwood
Dural Polymers of Canada Ltd.	955-2808 955-3429			●					●	Dean Murison
Duraprine Products Ltd.	250-9493 291-6616								●	Murv Woodworth
DYAD Engineering Ltd.	263-6600		●							Don Robin, Kaz Vinsome
DYAD Systems Group	259-3922 253-9053		●							Don Robin
Dynamic Reservoir Systems Ltd.	264-2343 263-8556		●							Jeff Waren
Echo Data Ltd.	269-5383					●				Wendy Steiner
Eddy Electronics Manuf. Ltd.	450-0164 469-6129					●	●		●	John Eddy
Edmonton Data Centre Ltd.	423-3503								●	Doug Wallace
Edmonton Economic Development Authority	424-7870 426-0535									
Edmonton Research Park	462-2121 428-5376	●	●	●	●	●	●	●	●	Glenn Mitchell See page A5-A6
Edmonton Telephones	441-2120	●								Bob David See page A39-A40
Educational Technology and Consulting	227-1463 227-1040	●	●				●			Dr. Barry Ellis

		Telecomm	Comp/Software	Advanced Industries	Bio/Pharm/Chem	Environmental/Oil	Electronics	Medical Devices	Adv. Mats./Engineer	
EEE TEE Digital Design Ltd.	Ph: 297-9790 Fax: 297-9799						●			Ed Taylor
EIM Controls Ltd.	243-1144 243-2975			●						R.L. Brews
Elec Western Medical Devices Ltd.	250-2568 291-5687							●		Wayne Krausler
Electronics Network of Alberta	289-2043						●			Dale Jansen
ELP Products Ltd.	279-2407 236-7919								●	Barry Ronallenfitch
Enerflex Systems Ltd.	236-6800 279-4341								●	John Aldred
ERCB Chemical Research Laboratories	297-2450 297-2882				●					Merl Kachinski
Erichsen Industries Ltd.	285-5710 293-6453								●	Norman Erichsen
Ernst & Young	290-4100 290-4265									Ian Robinson
ESSO Chemical Canada	420-8703			●						
Esso Research	284-7400 284-7589					●				Ken Putt
Estec Systems Corp.	483-7120 489-9557		●							Tony Nelson
Exchanger Industries	236-0166 279-8242								●	Blair Watmore
Expert Simulations Incorporated	450-0007 428-5376		●							Paul Chamberland
Exploration Seismic Ltd.	269-2529 266-2609					●				Chris Thomas
Extra Care Corp.	265-3035 233-2244				●					Bob Church
Fargo Print & Chemical Co. Ltd.	255-2936 259-5545								●	Frank A. Fargo
Fay's Software Ltd.	278-3439 424-5989		●							Yiu Fai Chow
Federal Pioneer Ltd.	525-3351 522-1490						●			Russel Boranowski
Field Aviation Company Ltd.	275-2111 275-0366								●	Stafford E. Wagstaff

		Telecomm	Comp/Software	Advanced Industries	Bio/Pharm/Chem	Environmental/Oil	Electronics	Medical Devices	Adv. Mats./Engineer	
Fitzpatrick Engineering Ltd.	Ph: 438-1581 Fax:								●	A. Fitzpatrick
Fleet Technology Lt.	253-4883 253-2070					●				Dr. Alan Murray
Fluor Daniel Canada Inc.	259-1110 259-1212								●	Sandy McArthur
Franger Canada Inc.	306- 484-4480 484-4490					●				Jack Twa
Frontier Mud Logging	289-6344 229-2788					●				Answering Machine
FTA Systems Ltd.	259-0087 254-8874		●							R. L. Thomlinson
FTM Systems Group	248-4440 273-7009		●							David Parker
Future Tech Micro Systems Ltd.	434-5637 468-5408		●							Stanley Mah
Gala Systems Group	262-4842 262-9775								●	Gordon Duff
Galvanic Analytical Systems Ltd.	253-6576 253-26[illegible]								●	Doug Fraser
Gastech Instruments Canada Ltd.	291-4700 291-2092					●				Jim Yaschuk
Gellman Hayward & Partners Ltd.	233-2713 262-7648								●	Tom Stark
Gemini Biochemical Research Ltd.	288-9133 932-2519				●					Ian Forester
[illegible]eneral Computer Systems	465-0737 468-4979	●	●			●				Dale Slugoski
[illegible]eneral Intermediates of [illegible]nada Ltd.	483-2783 483-2971				●					Dr. Kleiner
[illegible]enesis Communication Inc.	450-6516 428-5376	●								Jerry Vandyke
[illegible]enie Computer Services	295-0418 285-7172		●							Joseph Ho
[illegible]eo-Slope Programming Ltd.	269-2002 266-4851								●	John Krahn
[illegible]eo-X Systems	298-5600 264-1057								●	Don Simpson
[illegible]eochem Laboratories Canada Ltd.	291-4321 250-5421					●				Dr. G.S. Boyliss

		Telecomm	Comp/Software	Advanced Industries	Bio/Pharm/Chem	Environmental/Oil	Electronics	Medical Devices	Adv. Mats./Engineer	
Geophysical Cable Manufacturing Alberta Ltd.	Ph: 291-1100 Fax: 291-9547								●	Adv Manuf
Geophysical Microcomputer Applications Intl.	261-4025 263-6493		●							Dave Hood
George & Nick's Machine Works Ltd.	290-1720 265-2851								●	George Plesa
Geosignal Exploration	237-8454 262-7018					●				Mr. Hofer
Gilmor Laboratories Ltd.	922-2170 922-2219				●			●		Jim Watson
Global Laser Systems Inc.	448-0277 428-5376		●	●			●			Vern Polomski
Grant Geophysical	253-5511 253-2557					●				Lorne Munt
Gray Instruments Inc.	236-0388						●			Daniel Gray
Group 4 Systems Ltd.	246-7675		●							Michael Withers
GSR Technologies Ltd.	451-9000 451-1795		●				●		●	Myles Palmer
Gulf Canada Resources Ltd.	233-4000 233-5143					●				J.M. MacLeod
Gunnar Manufacturing Inc.	236-1828 236-1831			●						R. Quigley
Gunthers Building Centre Ltd.	243-3311 229-1636			●						Conrad Kockerbeck
Halliburton Services, Ltd.	269-6141 265-5750					●				Mr. Paulick
Hampson-Russell Software Services Ltd.	266-9380 266-9292	●								Dan Hampson
Harold A. Hansen & Associates	229-0696 245-9701									Mr. H. Hansen
Hartman Technica	277-6223 277-8507						●			Chris Hartman
Harvie Instruments Ltd.	347-6001 347-3150			●						Harvie Warkenton
Hayley Industrial Electronics	259-5523 253-1108						●			Noel Hayley
Hemisphere Engineering Inc.	452-1800 453-5205								●	John Chomick

		Telecomm	Comp/Software	Advanced Industries	Bio/Pharm/Chem	Environmental/Oil	Electronics	Medical Devices	Adv. Mats./Engineer	
Hemuset Pipeline Construction Ltd.	Ph: 236-0014 Fax: 279-9144								●	Arthur Hemuset
Heritage Medical Research Centre	492-6621 492-7303							●		Dr. Douglas Wilson
Hilltop Fittings Ltd.	250-2986 291-3592								●	Lee A. Krywitsky
Hilton Electronic Manufacturing	228-9845					●				Alan Hilton
Hoyme Manufacturing Inc.	672-6553 672-6554								●	Clifford Hoyme
HTI Technology Canada Ltd.	253-7505 252-7768				●					Vince Kryski
Husky Oil	298-6111 298-7464				●					Mr. Arthur Price See page A13
Hycal Energy Research Laboratories Ltd.	250-5800 291-0481				●					Dr. D.W. Bennion
Hyprotech Ltd.	283-7710 283-4764		●							William Sureck
I.D. Sharp Assoc. Ltd.	264-9648									Ian Sharp
Ikocem Electronics Ltd.	462-4545 462-4869									Walter Stein
IMX Systems Corp. Ltd.	259-2478									
ndel Davis Ltd.	252-7707 253-8007		●							Steeve Sarmanli
ndustra-Lube Testing boratories Inc.	438-3941 437-4308		●							Dever Chisholm
formation Technologies	263-7355 263-7522		●							Lance Selock
novage Microsystems Inc.	255-9590 258-7441						●			Michael Kaiser
star Corporation	264-7274 264-7286		●							Graham Irving
strument Service boratories	463-7488 463-7450									
tegrated Metallurgical rvices Ltd.	279-2666 279-2281			●						Mr. Wynker
ter-Soft Systems	255-2022 259-2042		●							Jim Burney

		Telecomm	Comp/Software	Advanced Industries	Bio/Pharm/Chem	Environment/Oil	Electronics	Medical Devices	Adv. Man./Engineer	
Intera Technologies Corp./Inter Technol	Ph: 266-0900 Fax: 265-0499	●								Brian Bullock
Interalia Inc.	288-2706 288-5935					●				Garth Hunter
Intergraph Systems Ltd.	250-6100 250-6102		●							Merv Swan
International Radiochemical Centre Inc.	469-0653				●	●				Dr. John Tse
Intrex Traffic Control Products	459-6092 466-7813					●				Brian Williams
Inventronics Limited	461-5010 450-0234								●	Grant Shannon See page A18
Ipexo Control Systems Ltd.	269-8378 269-9065		●							Werner Brock
ITA Inverse Theory & Applications Inc.	269-4669 263-7099		●							Mark Klingbil
Itres Research Ltd.	274-7440 295-3570					●				Dr. Clifford Anger
ITT Canada Industries	291-4814 291-5678	●								Joe Incontri
J.A.V. Systems Development Ltd.	288-6164		●							John Verral
Jade Simulations International Corp.	282-5711 289-6876		●							Brian Ungar
Jager Industries Inc.	259-0700 255-6008			●						W. Jager
JDA Software Service Ltd.	255-9317 252-9605		●							Doug Marlin
K. Stuart Associates Ltd.	269-8824		●							Ken Stuart
Kairos Consulting Inc.	295-1330 295-3570		●							Dr. David Mitchell
Kakari Systems Ltd.	426-5716 425-1531		●						●	Chuck Elliot
Karl Hagar Limb and Brace, Ltd.	452-5771 452-2752							●		Frank Hayday
Kary Data	262-7021 262-1392				●					Mike Kary Sr.
Kasten Eadie Engineering Inc.	451-9101 452-9083					●				Bill Eadie

		Telecomm	Comp./Software	Advanced Industries	Bio/Pharm./Chem	Environment/Oil	Electronics	Medical Devices	Adv. Man./Engineer	
Kelman Seismic Processing	Ph: 262-5220 Fax: 263-1518								●	Gary Kelman
Kenonic Controls Ltd.	258-6200 258-6201								●	Ken Netzel
Kestrel Data Ltd.	250-1119 291-2921		●							Glen Gray
Keyword Office Technologies Ltd.	250-1770 250-1964		●							Robert Blackshaw See page A3-A4
Kwok and Co Inc.	438-7277 436-1321		●							Henry Kwol
Lakusta Compression Equipment Ltd.	243-8800 243-3155								●	Vic Lakusta
Landis, Gyr & Powers	259-3404 252-8578					●				Jean Sullivan
Laser Software Ltd.	233-0600 266-1936		●							Ken Gray
Lawmax Corporation	462-2244 462-1271		●							George Anderson
Leaf Electronics	458-3836		●		●	●	●	●		Ron Lentz
Legrand Industries	253-0117 252-2117					●			●	Graham D. Ross
LGS Group Inc.	482-7127 488-1364		●							Michael Bell
Liberty Boilers (1982) Ltd.	327-3921 328-5794								●	Scott Henderson
Link Hospitality Consultants Ltd.	266-8750 290-1832		●							Carl Link
Liquid Carbonic Inc.	463-8811 462-0878			●						Ron Fisher
Logan Group	250-5600 250-5676		●							Allan Heslop
LSI-Logic Corp of Canada Inc.	262-9292 262-9494						●		●	Perry Constanting
Lynx Energy Service Ltd.	264-0650 261-2497			●		●				Vern Lyons
M.W. Kellogg Company	269-8232 290-5431					●				Robert Low
Mackie Agencies Ltd.	233-7413					●				Lorne Mackie

		Telecomm	Comp./Software	Advanced Industries	Bio/Pharm./Chem	Environment/Oil	Electronics	Medical Devices	Adv. Man./Engineer	
Madenta Communications Inc.	Ph: 450-8926 Fax: 428-5376		●							Randy Marsden
Magna IV Engineering Ltd.	462-3111 450-2994					●				D. A. Peterson
Mainland Hydraulics Ltd.	253-3025 253-3038			●						John Mullen
Maloney Steel Ltd.	279-5000 279-2068								●	James Wolter
Management Information Group (Alberta) Ltd.	458-8722 460-2625		●							Ash Kahn
Maple Medical Laboratories	461-9704				●	●		●		Dr. Vinyaga Morthy
Marimex Instruments Inc.	252-8800 252-9557					●			●	Dietmar Brand
Mark Products	275-3544 295-1805								●	Mr. L. Shaw
Martin & Company, Ltd.	329-0050 329-6594		●							Allan Martin
Master Flo Values Inc.	468-4433 469-9853			●		●			●	J.D. McNeil
Master Flo Valve Inc.	468-4433 469-9853								●	Bob Evans
Matheson Gas Products Canada Inc.	471-4036 471-3117			●						Jan VanderBit
McAllister Petroleum Services Inc.	250-1911 250-8738		●			●				Jack Still
McElhaney Group Ltd.	245-4711 229-9160		●							Bernie McKenna
Mecalta Industries Ltd.	285-1112 293-6008					●				John Meyer
Mega Technical Industries	450-3022 461-8378	●		●		●		●	●	Robert Lindsay
Micro Support Group	469-1385 469-5822		●							Glen Skolney
Micro Systems Unlimited	250-9113		●							Michael Finch
Micro Watt Control Devices Ltd.	250-1594 291-6671								●	Ken Coffey See page A16
Microhmega Electronics Ltd.	255-6673					●				Answering Machine

		Telecomm	Comp/Software	Advanced Industries	Bio/Pharm/Chem	Environment/Oil	Electronics	Medical Devices	Adv. Mat./Engineer	
Micrologic Ltd.	Ph: 250-2911 Fax: 250-5009		●							Robert Atkins
Microsim Software Inc.	297-9100		●							Mr. Agbi See page A8
Millway Industries Ltd.	287-2430 243-8748							●		John Conway
Mimco Enterprises Ltd.	269-3430 262-5189				●					Ivin Koloulas
Mitre Software Corporation	438-1460		●							John Graham
Mits Computer Systems Ltd.	273-3530 273-3868		●							Don Bell
MJ Data Consultants Ltd.	262-6020 264-2122				●					Phil Peterson
MJ Systems	244-8431 242-7400							●		Peter Westo
MMS-Medical Management Service Ltd.	274-2293						●			Mike Coombe
Mobiltex Data Ltd.	291-2770 250-6795							●		Dale Poloway
Monenco Pipeline Consultants	298-4170 298-4125							●		A.J. Cressey
Mount Royal College	240-6111									Hunter White
Mountainview Electric	252-7447 252-1156							●		John Somoya
MSR Magmeter Mfg. Ltd.	455-2623 452-4191		●		●	●		●		Paul Mahler
Mtech Ltd.	261-5055 266-1462				●					Conrad Delorme
Munro Engineering Inc.	263-0070 262-1929		●		●					Rod Munro
Music Technologies	425-8240 425-6623		●			●				Grant Beattie
Nerias Research Corp.	427-1616 421-8979		●							Ted White
Nardie Fabrication Ltd.	279-3301 279-5871							●		Mr. R. Nardie
Natco	236-1850 236-0488							●		W.G. Child

		Telecomm	Comp/Software	Advanced Industries	Bio/Pharm/Chem	Environment/Oil	Electronics	Medical Devices	Adv. Man./Engineer	
Neotechnology Consultants Ltd.	Ph: 291-1020 Fax: 291-0634		●			●				Garry Gregory
Newalta Corporation	266-6556 265-9034					●				Owen Pinnell
Newco Saftey Tel. Inc.	228-3605 229-9321	●								Robert Gentles
Nichols Advanced Technologies Inc.	424-0091 428-7644		●							Bruce Butler
Nilex Geotechnical Products Inc.	463-9535 463-1773					●				Jack Fujine
Nomoco Corp.	253-0222					●				Ralph Herron
Norac Technologies Inc.	461-7163 450-1016				●					Richard Caron
Norcard Energy Service Ltd.	290-0264 265-6142					●				Jack Churchwood
Norcen Energy Resources ALtd.	231-0111 231-0187					●				Edward Battle
Nortech Surveys Canada	262-0800 262-0810	●	●			●	●			Brian Cutting
North American Vision Co. Ltd.	262-7766							●		Roger Wetzel
Northeastern Drilling Ltd.	265-6361 266-3596					●				George Ward
Northern Alberta Institute of Technology	471-7400 471-8583	●	●	●	●	●	●	●	●	Dr. Stan Souch See page A30
Northern Computer Logic Inc.	423-2937 352-4929		●							Ralph Rasmuson
Northern Telecom Canada Limited	441-3100	●								
Northwest Computer Services Ltd.	482-3482 488-0783		●							Scott Dutton
Northwest Industries Ltd.	890-6300									L. H. Prokip
Norwest Labs	438-5522 438-0396		●			●				Jean Michel Crepin See page A15
Nova an Alberta Corp.	290-6000 237-6102					●				Bob Blair See page. A9-A10
Nova Husky Research Corp.	250-4700 291-3208					●				George Miller

		Telecomm	Comp/Software	Advanced Industries	Bio/Pharm/Chem	Environment/Oil	Electronics	Medical Devices	Adv. Mats./Engineer	
Novatel Communications Ltd.	Ph: 295-4500 Fax: 295-0230	●						●		Del Lippert
Novatex Manufacturing Canada Ltd.	279-6673 236-0652			●				●		Mr. B. Nurani
Nowesco Industries 1983 Ltd.	258-3883 259-5823							●		Vern Stevens
Nowsco Well Service Ltd.	261-2990 262-8066					●				S.P. Shouldice
NRG Engineering Ltd.	262-3346 237-5047							●		Raj Agrawal
Nutron Manufacturing Ltd.	468-2732 466-7741							●		Dan Worley
Omniteck Computer Systems Ltd.	291-2988 291-6671					●				
On-Site Power Ltd.	263-4540 288-5366							●		G.W. Stephens
Opsco Industries Ltd.	272-2206 273-0377					●				Harvey Prang
OYO Geo Space Canada Ltd.	232-3050 243-6220					●				Forest Anklovitch
Palco Telecom Ltd.	255-4481 259-0101					●				Wolfgray Teppler
Palliser Animal Health Laboratories, Ltd.	328-1844 328-1798				●					Collin Darcell
Partec Lavalin Inc.	292-2100 237-8365					●				Donald Park
Pelorus Navigation Systems Inc.	250-9377 291-9123	●	●	●		●	●			Don Sinclair
Petrel Robertson Ltd.	250-8299 291-9355							●		Mike Doyle
Petro Equipment Sales Ltd.	243-4773 243-4491							●		George Sears
Petro Sytems Services	258-0196							●		Robert Hilton
Petro-Canada Resources	296-8000 296-3030					●				James M. Stanford
Petrogas Processing Ltd.	234-6700 263-5673					●				Agnus McKee
Petrotech Lavalin Inc.	294-2100 237-8365							●		Donald Park

		Telecomm	Comp./Software	Advanced Industries	Bio/Pharm./Chem	Environment/Oil	Electronics	Medical Devices	Adv. Mat./Engineer	
Petwa Deionization Inc.	Ph: 250-2850 Fax: 291-5251				●					Jim Robinson
Pheonix Data Trend Ltd.	248-3282 235-3722		●							Wolfgang Rochow
PHH Engineering Ltd.	232-6822 232-6764		●							
Photocomb Systems Inc.	556-4243		●							Bruce Waldie
PLD Systems Ltd.	248-3444 248-3668	●								John Tiberio
Polyphase Engineered Controls	465-3283								●	Ramesh Aggarwal
Porta Test Inc.	440-1122 440-1129					●			●	Len Rowley
Positec Drilling Controls (Canada) Ltd.	279-0139 279-5131								●	Gord Goodsman
Positive Tool Action Tool Western	237-6441 237-6445								●	John Bertagnolli
Prairie Biological Research	450-3957 450-3960				●	●		●		Ram Mehta See page A45
Prairie Industrial Chemicals Inc.	279-1096 236-0989			●	●					Jim Yuel
Praxis Consulting	245-6404 229-2037								●	Richard Roberts
Presson Manufacturing Ltd.	955-2447 955-8058								●	Kelly Smith
Priority Projects Ltd.	436-6530 436-1621									Gord Hougestol
Procor Ltd.	253-5969 259-2771								●	Lorne Peppler
Procor Ltd.	264-1773 266-5135								●	Randy Hall
Profissional Computer Center	294-1778 294-1805		●							Robert Lloyd
Proline Pipe Eqpt.	465-6161 469-3590			●					●	Ray Smitke
Promet Environmental Group	275-0414 295-0699					●				Bill Murray
PSI Circuits Inc.	273-9896 248-7645						●			Robert Watson

		Telecomm	Comp./Software	Advanced Industries	Bio/Pharm./Chem	Environment/Oil	Electronics	Medical Devices	Adv. Man./Engineer	
PSI Energy Software Ltd.	Ph: 264-1072 Fax: 264-1442		●							James Malcolm
Pulsonic Geophysical Ltd.	255-2820 255-6637					●				Hugh Stanfield
PWCS Alberta Ltd.	939-4000 939-3228		●							Jim Estes
QC Data Collectors	269-3306 264-5338		●							Ken Meyer
Quality Hard Chrome Plating Inc.	461-8333 450-2899					●			●	L.W. Schlotter
Quantel Canada Inc.	236-2330 236-8843		●						●	David Bottein
Quill Resources Inc. (Canterra Electronics)									●	
Raffin Electric Co. Ltd.	252-7551 252-8436								●	Peter Raffin See page A17
Raffin Systems Ltd.	252-1633 258-3023								●	Kim Raffin See page A17
Rambridge Structure and Design Ltd.	230-5717 276-9120								●	Lorne Wagner
Randall Carlton and Associates Ltd.	429-3665 425-4570		●							Jim Lantz
Raylo Chemicals/Division of Terochem Lab	468-6060 468-4784				●					Gerard Tertzakian
Recom Engineering Ltd.	451-2020 452-9374								●	Josef Repsch
Redwing Tool Co. Ltd.	542-3522 542-4777								●	Joe Rezewski
Relcon Inc.	438-1133 438-4398		●	●			●		●	Paul Wright
Riley's Data-Share International Ltd.	291-3894 291-3894					●				Don Plewes
Riley's Seismic Processors	262-8800		●							Allan Richards
Rinax Systems Ltd.	243-4074 243-8009		●							John Wrenshall
RIS-Resources Information Systems	263-2272 265-7431		●							Peter Thompson
Robart Industrial Mfg.	255-4425 253-2986						●			Art Ruff

		Telecomm	Comp./Software	Advanced Industries	Bio/Pharm./Chem	Environment/Oil	Electronics	Medical Devices	Adv. Man./Engineer	
Rock Bit Industries	Ph: 255-3730 Fax: 255-3721								●	Larry Pederson
Ronden & Associates	450-5732 428-5376			●		●			●	Cliff Ronden
Rosemount Instrument Ltd.	275-8400 275-4331								●	Colin Kent
Rostel Industries	276-9785		●							York Tom
RSI-Detail Solutions, Inc.	279-0460 279-5201		●							Mark Boulton-Mills
RTS Electronic Manufacturing Ltd.	447-4189 447-4248						●			Ronald Ginther
Ruffneck Heaters Div. of Starozik	291-5488 291-7042								●	Ken Starozik
Ryerson Oil & Gas	294-1636 266-3881					●				James Cowie
Sabre Instrument Services Ltd.	258-0566 259-3107					●				Frank Klassen
Saf-T-Pak Inc.	486-0211 486-0235							●		Alma McConnell See page A27-A28
Schafer Engineering Service Ltd.	259-6765		●							Merv Schafer
Schema Systems Ltd.	255-9296		●							Keith Rutherford
Schulmberger of Canada	231-9600 269-3852					●				Mr. R. M. Bell
Sci-com Data Services	245-1111 229-2599		●							Gary Kalinski
Scientific Software Intercomp	265-6550 266-5202		●						●	Peter Stanton
Score Energy Products Inc.	742-4407 742-1058								●	Al Webster
Seis View Ltd.	269-6696 266-5743								●	Wade Brillion
Seis-Pro & Consultants Ltd.	233-2152 233-2151		●							Alan Hastman
Seis-Pro & Consultants Ltd.	233-2152 262-8679		●							Paul Dennis
Seischron Systems Inc.	262-6891 233-8304						●			Kenneth Davis

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Seisland Surveys Ltd.	Ph: 255-2770 Fax: 253-2049					●				Gavin Geck
Sequiter Software Inc.	439-8171		●							Ken Sawyer
Servnex Computer Systems Ltd.	272-6887		●							
Shaffer Western Hemisphere	465-9205 468-5442			●			●		●	Prem Sood
Shana Corporation	463-3330 428-5376		●							Don Murphy
Shaw Pipe Protection Ltd. (Alta.)	263-2255 264-3649				●					Les Shawn
Shell Canada	232-3111 232-4183	●	●	●	●	●	●	●	●	Jack McLeod
Sherrex Systems Ltd.	462-4085 450-8369						●			Wayne Sherrard
Sherritt Gordon Mines	992-5002 992-5010			●		●	●		●	Art McMullen See page A19-A22
Silatech Microsystems Inc.	228-3142 229-0651		●							Dan Mackay
Silicon Wings Inc.	286-8804 288-2201		●							Wayne Brown
Simtech Consulting Services	262-4885 263-8856					●				Toni Settari
Smart Technologies Inc.	233-9333 262-3524		●							David Martin
Smith International Canada Ltd.	264-6077 265-9877					●				Charles Beam
SMR Electronics Ltd.	285-3265 277-9928						●			Paul Conkin
Sobeco Lennox	264-9710 233-2795								●	Graham McFarlane
Software Integration Services Ltd.	420-0424 420-0429		●							Dean Perry
Software Research & Dev. Group U of C	220-6015 284-4707		●							Dr. Brian Gains
Solar Engineering Group Ltd.	289-7033 282-1238								●	Nabil Mansour
Soph-Text	466-5382		●							Carter Campbell

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Southern Alberta Institute of Technology	Ph: 284-8110 Fax: 284-8940	●	●	●	●	●	●	●	●	R.W.D. Erhardt
Sparton Controls Ltd.	250-7600 291-9893					●				Ron Kuchinka
Specialty Contact Lens	283-9506 283-1014							●	●	Bill Sturm
Speedco Drive Ltd.	253-8738 255-4323	●			●					Warren Single
Spencer Manufacturing (1983) Ltd.	438-4582						●			Jerry Spencer
SPI Synthetic Peptides	492-3155 492-7168		●		●			●		Stewart MacAllister
SRI System Resources Ltd.	245-1188 244-2558		●							James Wilson
Standins Ltd.	253-7611 253-6746								●	Mr. Iozzi
Star Technologies Ltd.	269-6115 234-8225		●							Phil Crowe
Statcom Ltd.	265-4111 266-1517		●							Peter Snethlage
Statscon Statistical Consulting	247-6772		●							Dr. Milo Nosal
Stewart Weir and Co.	451-6465 452-2316									Ray Ferguson
Stream Data Systems Ltd.	233-0690 266-4097		●							Mark Sondergaard
Stream-Flo Industries Ltd.	468-6789 469-9853								●	Bob Evans
Sulpher Corporation of Canada Ltd.	234-7700 234-7706				●					R.S. MacKenzie
Suncor	743-6419 743-6480			●		●			●	D. Parsons
Supercomputing Services	220-8440 284-2960		●						●	Rod Wittic
Surflo Meters & Controls Ltd.	875-5705 875-9030						●		●	Lloyd Nelson
Syncrude	790-6111 790-6526			●						Mavis Walmsley
Synerlogic Incl	237-6500 269-1363		●							Gordon Forbes

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Synertek Design Group	Ph: 291-4525 Fax: 250-9086								●	Bob Wright
Synphar Laboratories Inc.	462-4044				●					Dr. Ron Micetich
Systemhose	266-2266 262-4722		●							Ralph Gardner
Systems West CGI	425-1494 425-1498	●	●							Paul Rowsome
Taylor Industrial Software	482-7547 488-8030		●							Tom Jansing
TCR Control Systems Ltd.	258-0044 258-1462		●							Bob Toner
Tech-Cite Optical Laboratories co. Ltd.	230-4688 230-0298							●		Don Baker
Technica Resources Development Ltd.	269-4336 266-4395					●				Roy Lindseth
Technovation Systems	461-7518 428-5376		●			●			●	Dr. J. Ahmad
Technology, Research and Telecomunications	427-0567 420-1474	●	●	●	●	●	●	●	●	Tony Myers
Teconomics Inc.	265-0707 263-1067		●							Ba-Tien Duong
Tehnifluids/NMC Inc.	237-0346 269-7224					●				David O'Williams
The 10 Planner Corporation	264-1010 264-1442		●							Brian Harrington
The Alberta Microelectronic Centre	492-3914 492-1643				●					John Zupanic
The Dreco Group of Companies	463-2065 463-3276		●		●	●			●	Frank Kobie
The Laser Institute	436-9750 437-1240						●			Dr. Don McKen See page A23
Thermo Design Engineering Ltd.	440-6064 440-1657								●	James Montgomery
Thirsk Computer Consulting	238-1559		●							Richard Thirsk
Thuro Services (Western) Ltd.	243-0276 243-3371						●			Alex Varro
Tiger Chemicals Ltd.	279-2616 236-9049				●					Rich Schuster

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Top-Co Industries Ltd.	Ph: 440-4440 Fax: 440-4443								●	Albert Hennessey
Topco	230-1558 230-4591					●				Albert E. Plomp
Toromont Industries Ltd.	291-3438 291-3443								●	Dave Duncan
Total Computers, Ltd.	320-1448 320-5547		●							Brian Roelofs
Tower Aircraft Inc.	291-2264 250-8627								●	S. McLeod
Traders Tec-Systems Controls Ltd.	224-3666 224-3225								●	Dwayne Tester
Travco Industrial Housing Ltd.	955-7366 955-8938								●	Ralph Jamego See page A17
Travis Chemical, Inc.	263-8660 233-7011				●					Jim Banister
Trinity Electronics Systems Ltd.	489-3199 489-2258						●			Larry Kelly
Tron Industrial Automation Systems Inc.	273-6899 373-8115								●	Clif Skrypnyk
Tycor Electronic Products Ltd.	259-3200 253-0663						●			Will Frey
U. of A. - Dept. Comp. Science	492-2374		●							Dr. Wm. Armstrong
Umatac Industrial Processes	279-8080 236-0595					●				Mr . D. Kote
Unexsys Systems Inc.	423-3046 426-4300		●							Gordon Derk
United Chemical Co. Sherrit Gordon Ltd.	236-0163 236-8645								●	Dick Blair
Universal Power Corp.	250-3479 250-6711								●	Pat Dodge
University of Calgary	220-5110 282-7298	●	●	●	●	●	●	●	●	D. Michael Ward
Usher Canada Limited	484-4644 486-1134	●	●				●			Roger Leeman
Valmet Automation (Canada) Ltd.	253-8848 259-2926		●							Dave Jardine
Van Meurs & Associates	253-1161 255-2544					●				Pedrol Van Meurs

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Variperm (Canada) Ltd.	Ph: 250-7263 Fax: 250-9695					●				Bill Nurcoumb
Vencap Equities Alberta Ltd.	420-1171									R. A. Slator/Jan Goodwin
Ventech Diagnostic Inc.	279-2155 236-5720							●		Gordon Cornelius
Veritas Seismic (1987) Ltd.	266-9202 266-9292					●				Wilf Reynish
Versatech Industries	250-8000 291-5408					●				W.A. Meyer
Vertex Systems Resources Ltd.	266-3303 306- 265-2366					●				Bob Cheadle
Vicom Ltd.	452-4082 452-6087	●								Dan Chugg
Virtual Computing Services Ltd.	266-7440 264-5718		●							Hans Doer
Visitech Graphic Resources Inc.	269-4884 269-6767		●							Glen Krahulic
Vista Laboratories Ltd.	468-0020 465-9732			●	●		●	●		Colin Wylie
Vista Projects Group	255-3455 258-2192								●	Alex Cambell, Don Nygaard
Volk Presislon Industries Ltd.	230-3115 277-1417								●	Jay Scott
Vortex Microsystems Inc.	493-8103 493-8199									Jim Bulmer
VSL	423-4202 424-8165		●							Pat Potter
VTA Photogrammetric Consultants Ltd.	271-0841 278-8182		●							Vass Tsivos
W. Mueller and Associates	432-0615		●			●	●			W. Mueller
Walker Steel Corp. Ltd.	264-4146 269-4224					●				Tom Irvine
Wega-D Geophysical Ltd.	228-9448 228-6468					●				Werner Wenzel
Welchem Canada Ltd.	955-2222 955-7858			●						Nigel Boos
Wenzel Petroleum Consultants Ltd.	263-1135 237-8186					●				Edith Wenzel

		Telecomm	Comp/Software	Advanced Industries	Bio/Pharm/Chem	Environment/Oil	Electronics	Medical Devices	Adv. Mats./Engineer	
Wespen Industries Ltd.	Ph: 279-6254 Fax: 236-8722					●				Bipin Bhati
West Air Equipment Co. Ltd.	252-1177 252-1275							●		Bill Rutherford
West Canadian Graphic Industries (1986) Ltd.	245-2555 244-6426		●							George Brookman
Westech Industrial Ltd.	252-8803 253-6803			●						Ken Lapp
Western Atlas Intergrated Technol	234-7383 269-1796							●		Phillip Pantella
Western Co-operative Fertilizers Ltd.	279-1212 279-1141				●					Conrad Komitsch
Western Geophysical Co. of Canada Ltd.	291-8100 250-8220					●				Leo Dunn, Rick Ward
Western Industrial Systems Ltd.	461-5193 428-5376		●					●		John Antonio
Western Instruments Inc.	484-2410 484-3386					●				Mark Palynchuk
Western Research	291-1313 291-1128					●				Joe Lukacs
Western Rotocraft Ltd.	259-8911 274-1997							●		Jack Hardock
Westronic Inc.	243-3335 243-1815							●		Lyle Wharton
Winchester Data Products	461-4331 462-5724					●				Blaine Maber
Winterhawks Development Ltd.	270-7709 270-7342							●		Len Sukovieff
Yermac Data Systems	487-2912		●							Ken Yerex
Z.I. Probes Inc.	462-3400 463-1567					●		●		Donald Clark
Zard Aerospace Research & Development Ltd.	274-7066 275-5623							●		Brian Hval
ZCL Mfg. Canada Inc.	449-6080 449-5186	●		●		●		●		Ven Cote

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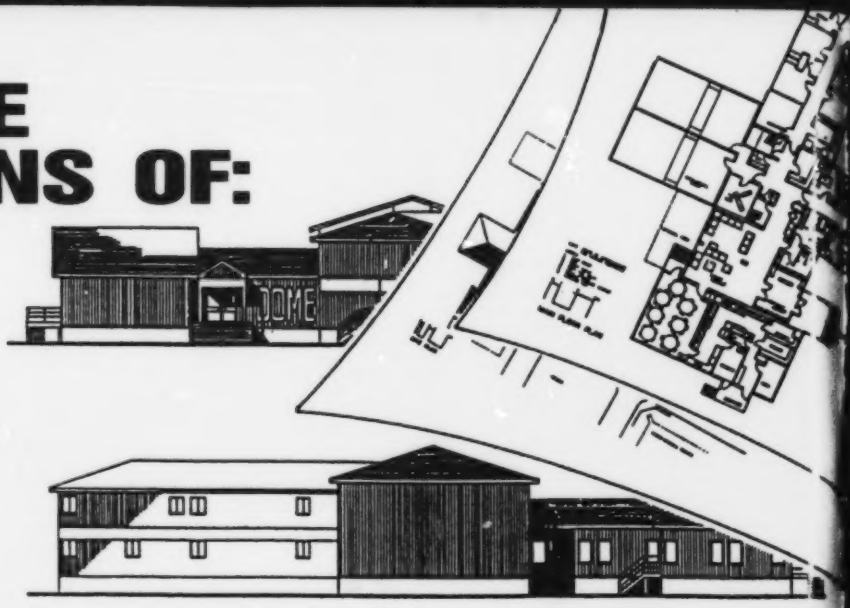

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